FISHERIES HABITAT EVALUATION ON TRIBUTARIES OF THE COEUR d'ALENE INDIAN RESERVATION

ANNUAL REPORT

Prepared by:

Kelly L. Lillengreen
D. Chad Johnson
Allan T. Scholz

Upper Columbia United Tribes Fisheries Center
Department of Biology
Eastern Washington University

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

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EXECUTIVE SUMMARY

The purpose of this study was to conduct physical and biological surveys of streams located on the Coeur d'Alene Indian Reservation. Surveys were designed to collect information on improving spawning habitat, rearing habitat, and access to spawning tributaries for bull trout and cutthroat trout and to evaluate the existing fish stocks.

The objectives of the second year of the study were to:

1. Develop a stream ranking system to select the five streams of primary fisheries potential.
2. Conduct physical field surveys.
3. Determine population dynamics.
4. Determine growth rates of existing trout species.
5. Determine macroinvertebrate densities and diversities, and,
6. Determine baseline angler utilization.

The Missouri method of evaluating stream reaches was modified and utilized to rank the ten tributaries (as determined by Graves et *al.*,1 990) associated with reservation lands. The method incorporated such data as stream bank and bed stability, condition of riparian vegetation, land use, degree of urbanization, passage barriers, water quality, flow and temperature regimes, as well as the overall habitat suitability for all life history stages of cutthroat and bull trout. This data was then combined with relative abundance data, growth rates and invertebrate densities to choose five streams, which offer the best potential habitat, for further study.

Relative abundance estimates resulted in the capture of 6,138 fish from June, August, and October, 1991. A total of 427 cutthroat trout were collected from all sampled tributaries. Relative abundance of cutthroat trout for all tributaries was 6.7%. Fighting Creek had the highest abundance of cutthroat trout at 93.1%, followed by Evans Creeks at 30.8%, Lake Creek at 12.1%, Hell's Gulch at 11 .l%, Alder Creek at 3.3%, Benewah Creek at 2.1% and Plummer/Little Plummer creeks at 5%.

Population estimates were conducted in Benewah, Alder, Evans and Lake creeks. Estimates were: 23.5 ± 2.3 fish/l ,922.6 m2 in Benewah Creek, 15.3 ± 2.1 fish/l ,039.6 m2 in Alder Creek, 69.1 ±

36.4 fish/857.1 m2 in Lake Creek, and 120.6 ± 20.5 fish/634.4 m2 in Evans Creek.

Growth rates and condition factors for cutthroat captured in each stream tended to be low in comparison to other streams in the region except for Benewah Creek. Eastern brook trout growth and condition factors were good in relation to other streams in the region.

Mean annual invertebrate densities in the tributaries ranged from 1205.3 organisms/m2 in Alder Creek to 2885.56 organisms/m2 in Evans Creek. Mean annual densities in the drift ranged from 21.3 organisms/m2 in Alder Creek to 265.7 organisms/m2 in Evans Creek. Invertebrate densities were comparable to other streams of the same size in the region.

Angler effort was determined to be minimal to nonexistent. Compliance with Idaho fish and game regulations regarding stream closures during spawning migrations limited the amount of angler utilization within the tributaries. Low to intermittent flow conditions in the tributaries during open fishing season also decreased angler pressure. Fishing pressure was heaviest by tribal members in late May during peak spawning runs. When runs began to diminish, fishing pressure declined. Fishing pressure was heaviest on those tributaries that were known to have existing runs of cutthroat trout such as Benewah and Lake creeks. Due to the lack of anglers, creel census were eliminated in early August.

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1 .O INTRODUCTION

Bull and cutthroat trout were two species of salmonids native to the Lake Coeur d'Alene system. Historically these species were fished by the Coeur d'Alene Indians. Both species have been greatly reduced in occurrence in the last 100 years. Both species are currently of special concern (Johnson 1987) due to declining population numbers and continued reduction of habitat (Spahr 1991). A complete discussion of the fisheries management history of the Coeur d'Alene basin is contained in Graves et *a/* (1990).

In 1987 the Northwest Power Planning Council amended the Columbia River Basin Fish and Wildlife Program, directing the Boneville Power Administration (BPA) to fund, *"A baseline stream survey of tributaries located on the Coeur d' Alene Indian Reservation to compile information on improving spawning habitat, rearing habitat, and access to spawning tributaries for bull trout (Salvelinus confluentus), cutthroat trout (Qncorhynchus clarki) and to evaluate the existing fish stocks. If justified by the results of the survey, fund the design, construction and operation of a cutthroat and bull trout hatchery on the Coeur d'Alene Reservation; necessary habitat improvement projects; and a three-year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects. If the baseline survey indicates a better alternative than construction of a fish hatchery, the Coeur d'Alene Tribe will submit an alternative plan for consideration in program amendment proceedings."* In 1990, BPA contracted the Coeur d'Alene Tribe to perform this study.

Twenty one creeks, flowing into Coeur d'Alene Lake, The St. Joe River and the St. Maries River, were initially identified within the study area as potentially useful for trout species. Data obtained from a helicopter survey further determined that only ten creeks which included; Fighting, Bellgrove, Lake, Squaw, Little Plummer, Plummer, Benewah, Hells Gulch, Evans and Alder creeks contained potential trout habitat.

The Three-phase study objectives are as follows:

1. Identify from twenty tributaries (as outlined in Graves *et a/*,1990), four tributaries best suited for habitat improvement by compiling information on spawning and rearing habitat and accessibility to spawning tributaries for cutthroat and bull trout.

2. Fund the design, construction and operation of a cutthroat and bull trout hatchery and necessary habitat improvement projects.

3. Conduct a three-year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects.

The purpose of this phase of the study is to compile information on improving spawning habitat, rearing habitat, and access to spawning tributaries for bull and cutthroat troutand to evaluate the existing fish stocks. The objectives of this study were to collect information on:

1. Population dynamics (including relative abundance, population estimates, natural and fishing mortality.).

2. Growth rates

3. Behavior patterns (i.e., migratory tendencies): and

4. Factors limiting fish production (e.g., habitat availability, food availability).

At the end of the study, the information will be combined to develop recommendations for enhancement projects, cost estimates for each alternative and estimates for success (in terms of increasing fish production) of each alternative. Upon completion of these tasks recommendations for bull and cutthroat trout enhancement projects will be submitted to the Northwest Power Planning Council.

This report contains the findings of the second year of the project. Objectives of the second year were to:

1. Develop a stream ranking system that defines the top five streams most acceptable for rehabilitation for bull and cutthroat trout populations. Ranking was accomplished through modifications of the Missouri method of evaluating stream habitat.

2. Conduct ground surveys identifying:

   a. Length of suitable fish habitat.

b. General physical stream features, including flow. temperature, pH, dissolved oxygen, total dissolved solids, conductivity, nitrate, nitrite, alkalinity and phosphate.
c. Relative abundance of fish species in the study section.

3. Determine population levels of cutthroat and bull trout in each primary tributary

4. If possible, assess age, growth and condition of cutthroat and bull trout in each stream, if possible.

5. Determine macroinvertebrate densities and diversities in comparison to similar stream systems.

6. Determine baseline angler utilization and fish biomass harvested in priority streams.

7. Begin habitat surveys of selected primary tributaries.

2.0. MATERIALS AND METHODS

2.1. Description of the study area

The Coeur d'Alene drainage basin is located in the Idaho panhandle and drains approximately 9,583.O square kilometers. It is divided into two subbasins, which includes the Coeur d'Alene River and the St. Joe River Basin. The Coeur d'Alene River basin, located east and north of the lake, drains approximately 3,859 square kilometers, while the St. Joe River Basin, located east and south of Coeur d'Alene Lake drains approximately 4,891 .I square kilometers (Figure 2.1). The remaining 9% of the drainage basin consists of creeks flowing into Wolf Lodge Bay and Corbin Bay on the east side of the lake, and Windy, Rockford, Mica and Cougar bays on the west side of the lake.

The study area encompasses ten tributaries located within the Coeur d'Alene drainage basin, including: Bellgrove, Fighting, Hell's Gulch, Squaw, Plummer, Little Plummer, Benewah, Lake, Evans, and Alder creeks. A full description of these creeks can be found in Graves et *al* (1990). Hell's Gulch, Lake and Evans creeks are third order tributaries while all the rest are fourth order drainages.

Table 2.1 lists the locations of sample sites for relative abundance and population estimates for each creek, while figures 2.2-2.9 shows relative abundance, population estimates, macroinvertebrate densities and water quality sample sites for each creek.

2.2. PHYSICAL INVESTIGATIONS

2.2.1. Habitat quality index model to select primary tributaries.

A modified Missouri Habitat Quality Index (Fajen and Wehnes 1981) was used to rank the ten previously selected Coeur d'Alene tributaries in terms of their potential for cutthroat and bull trout habitat.

Fourteen components including seven habitat quality parameters and seven habitat alteration functions were used for stream rankings. The seven components habitat quality parameters were rated on a scale of zero to ten. The first six of the habitat

Table 2.1 Location of relative abundance, water quality and benthic macroinvertebrate sampling sites.

Stream name	Site	Location
Bellgrove/Fighting	1	R4W T48N Sec. 7 se1/4 sw1/4
Hell's Gulch	1	R2W T46N Sec. 6 nw1/4 se l/4
Plummer/L. Plummer	1	R4W T46n Sec. 2 sw1/4 ne1/4
	2	R4W T46 Sec. 10 sw1/4 swl/4
	3	R4W T46 Sec. 3 ne1/4 ne114
Benewah	1	
	2	
	3	
	4	R4W T45n Sec. 26 ne114 ne l/4
Lake	1	R5W T48n Sec. 21 nw1/4 sw1/4
	2	R6W T48n Sec. 12 sw l/4 nw1/4
Evans	1	R2W T47n Sec. 3 se1/4 se l/4
	2	R2W T47n Sec. 12 ne1/4 se1/4
Alder	1	R3W T45n Sec. 36 nw1/4nw1/4
	2	R3W T45n Sec. 33 sw1/4 nw1/4

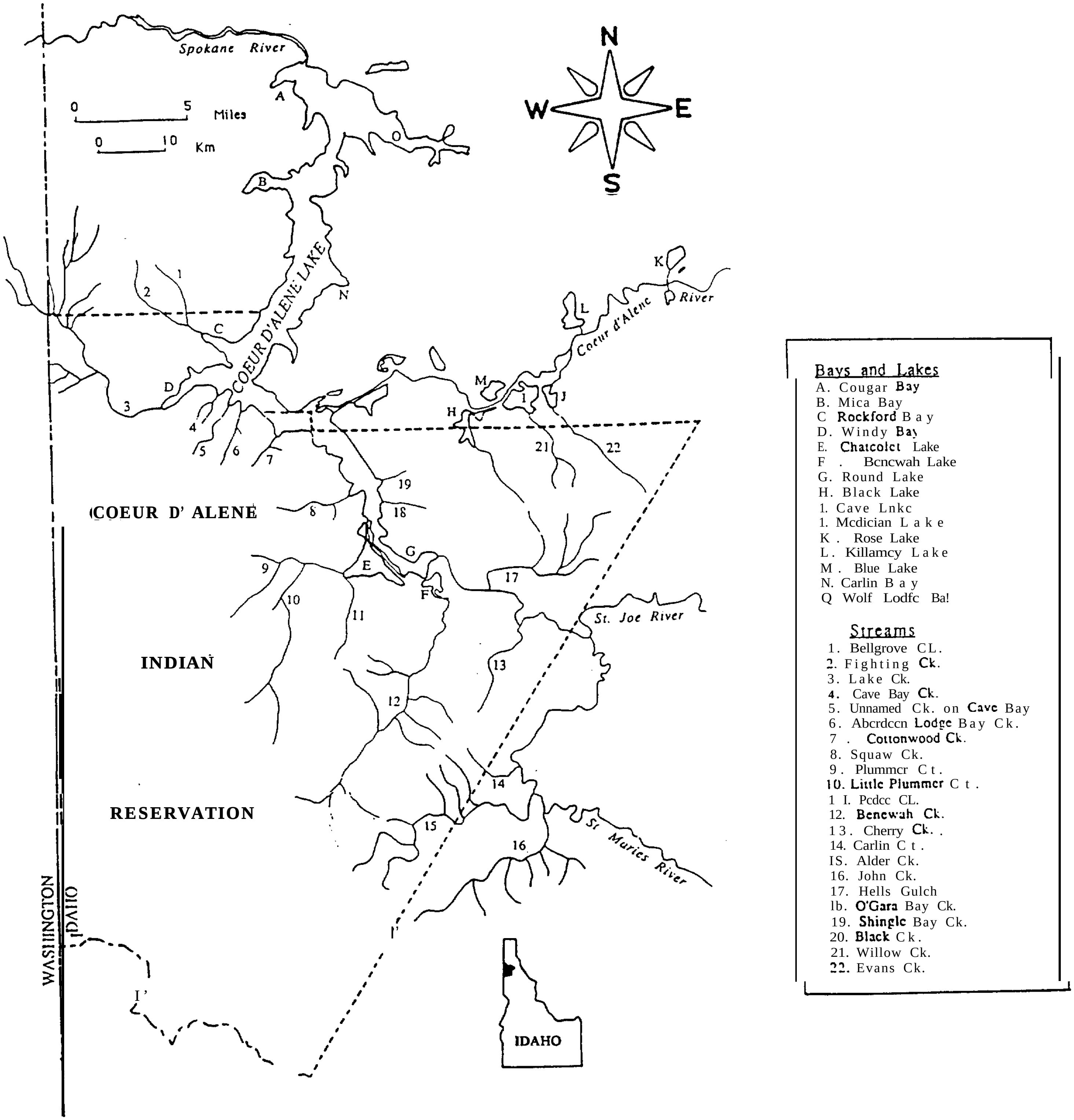


Figure 2.1. **Map of the Coeur d'Alene drainage basin.**

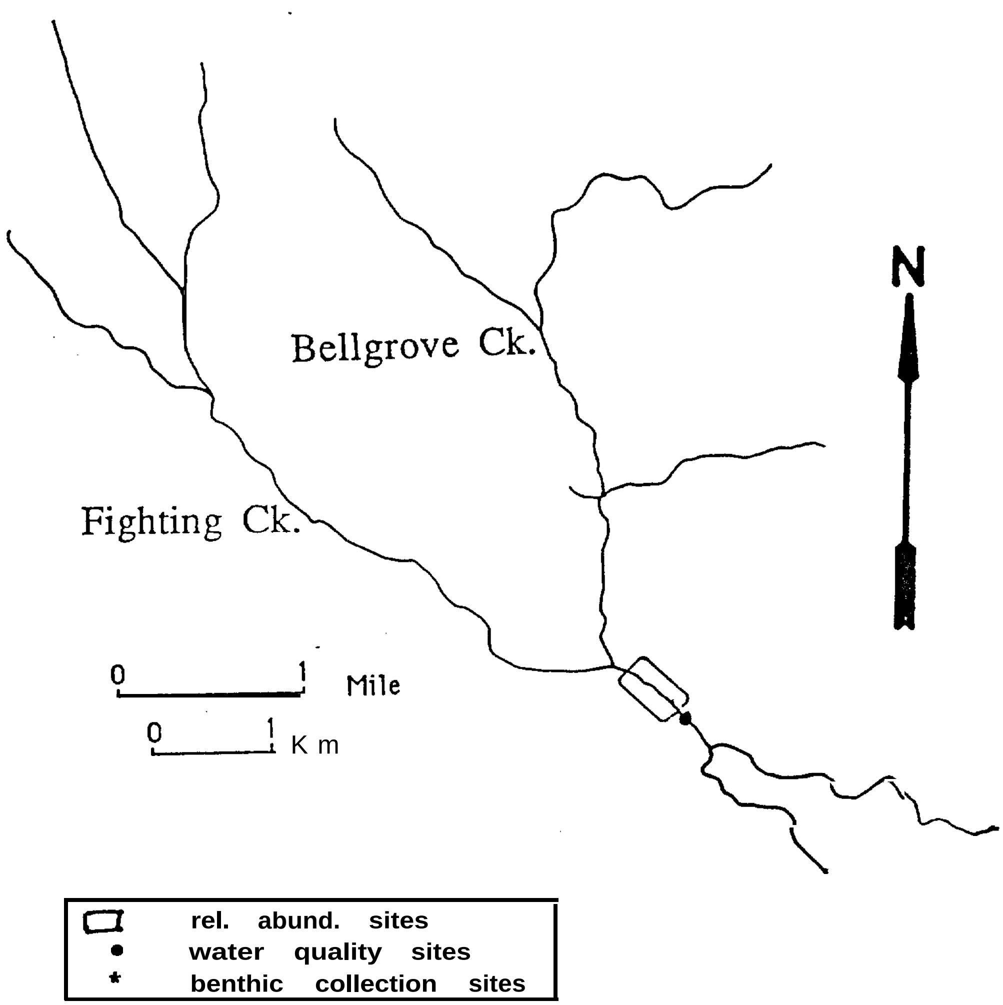


Figure 2.2. Map of Bellgrove and Fighting creeks showing the locations of the relative abundance, benthic macroinvertebrates and water quality stations.

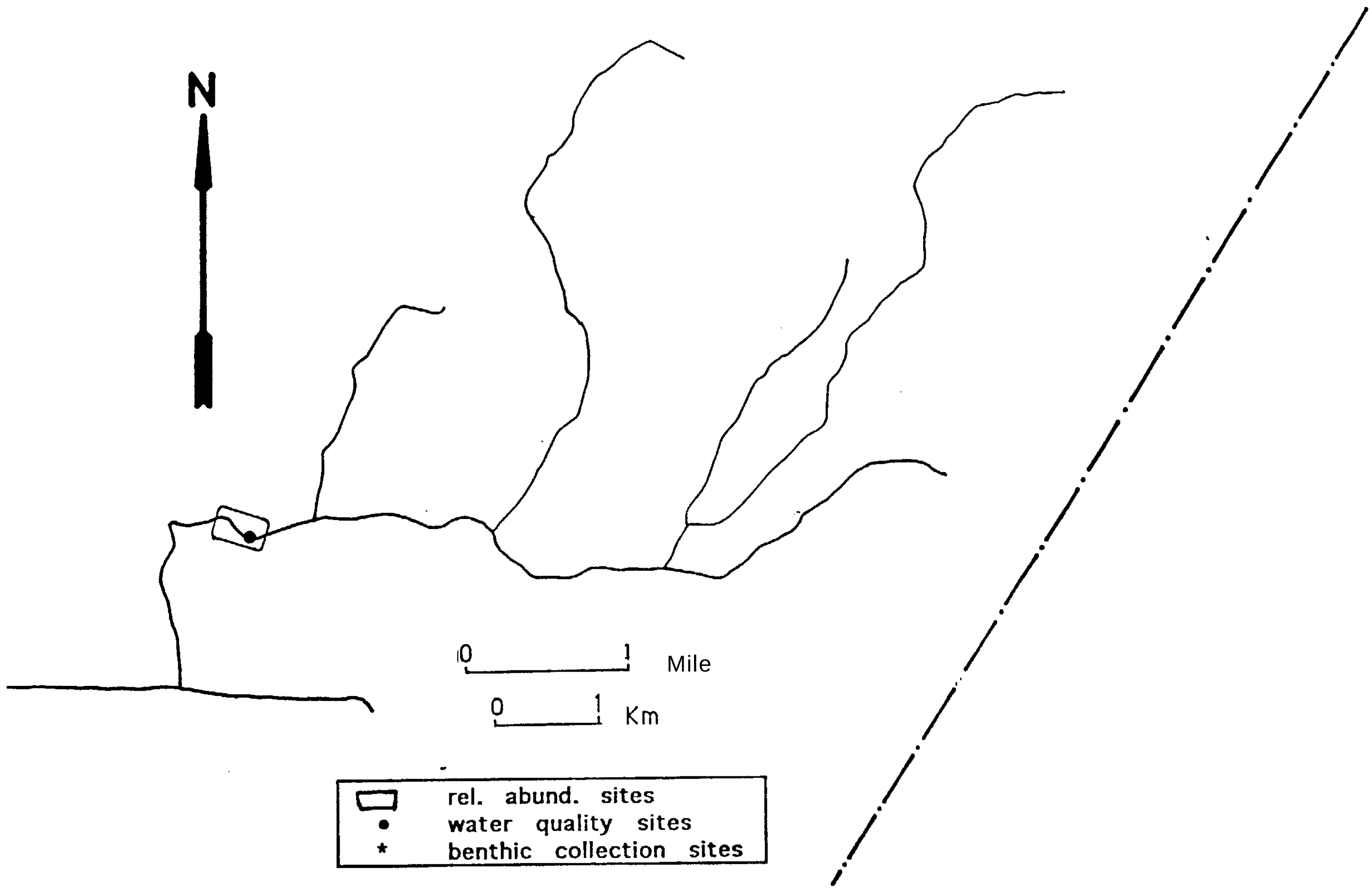
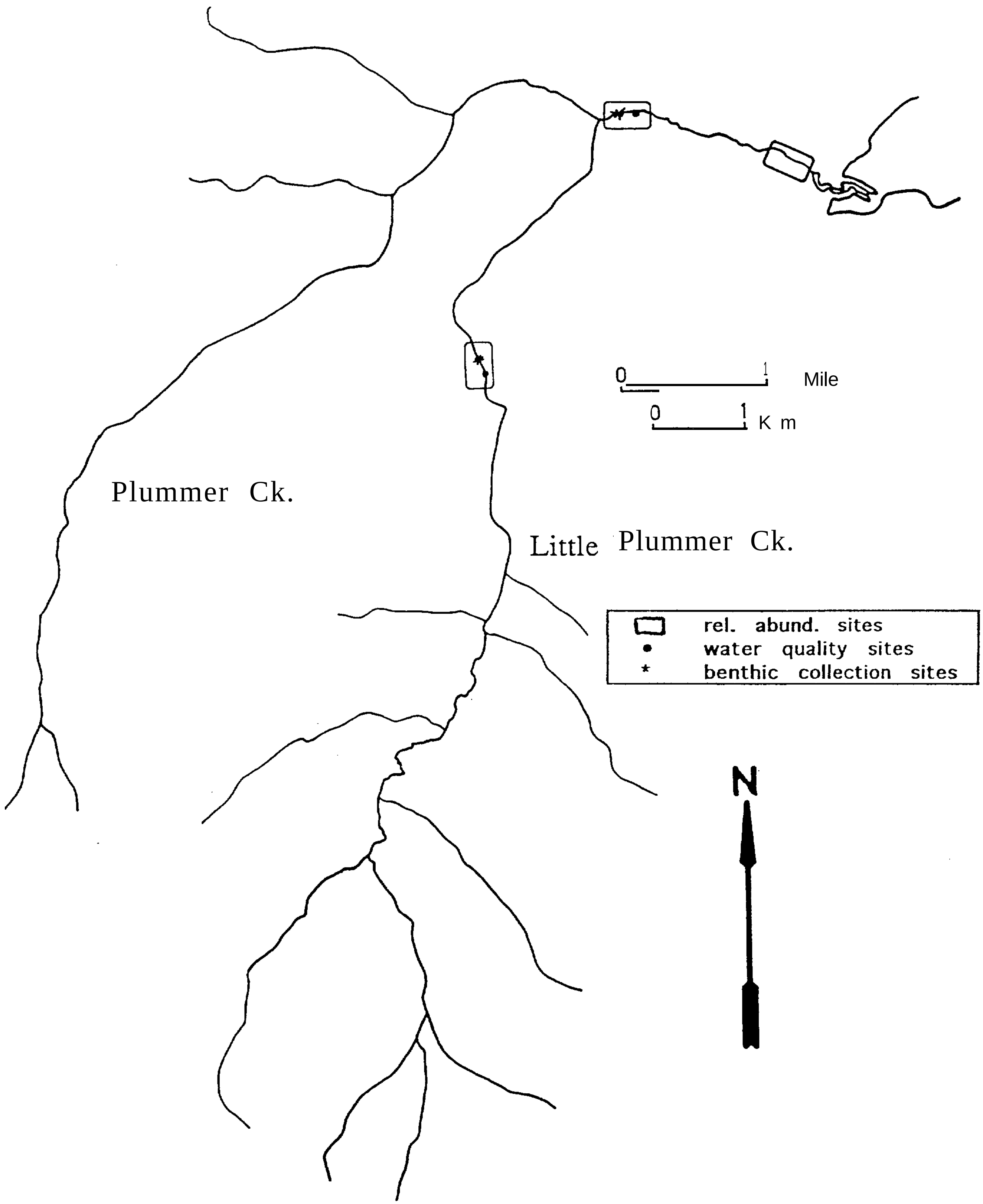


Figure 2.3. **Map** of Hell's Gulch showing the locations of the relative **abundance**, benthic macroinvertebrates and water quality stations.

Figure 2.4. Map of Squaw Creek showing the locations of the relative abundance benthic macroinvertebrates and water quality stations.



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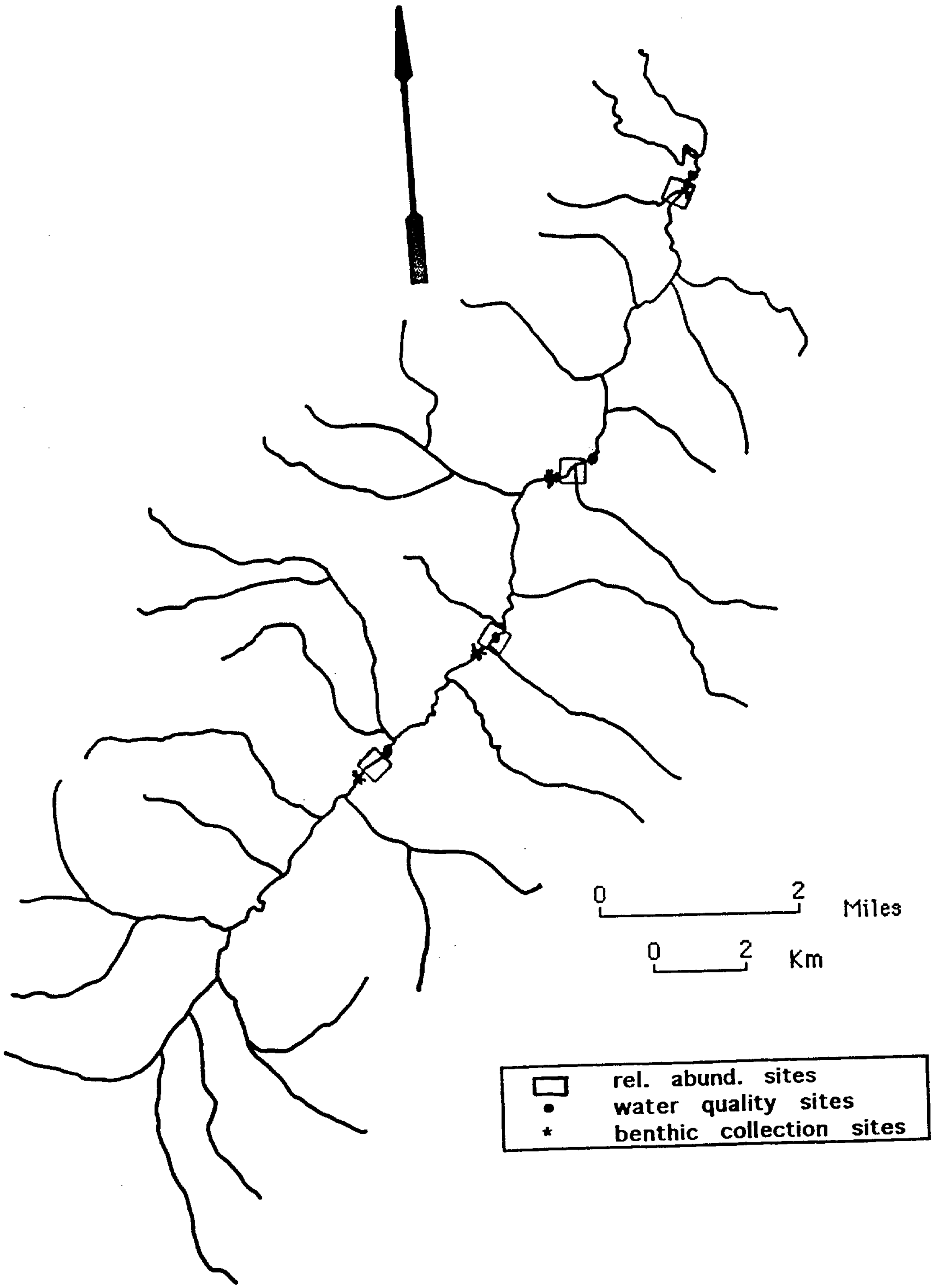
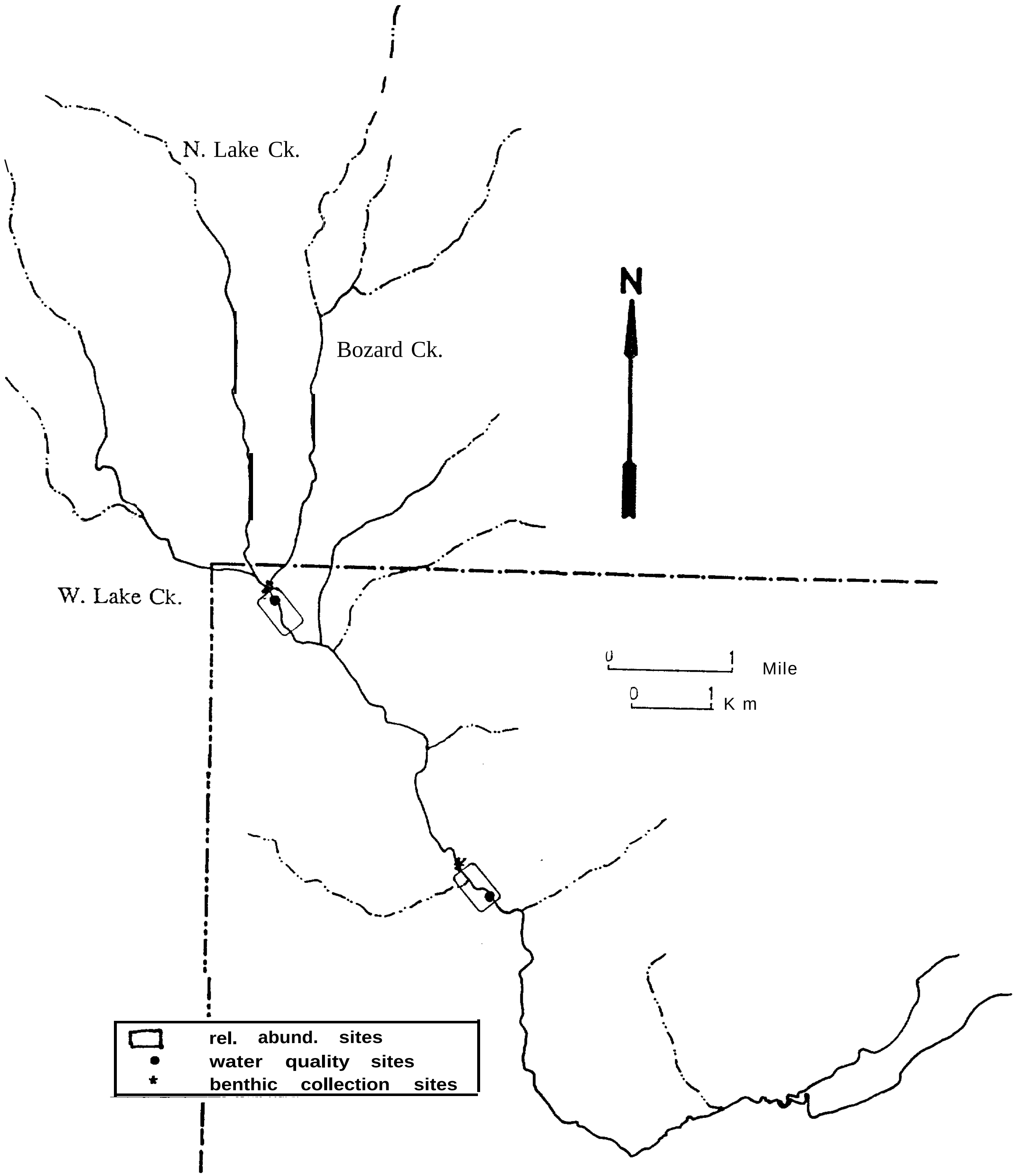


Figure 2.6. **Map of Benewah Creek showing the locations of the relative abudance, benthic macroinvertebrate and water quality stations.**



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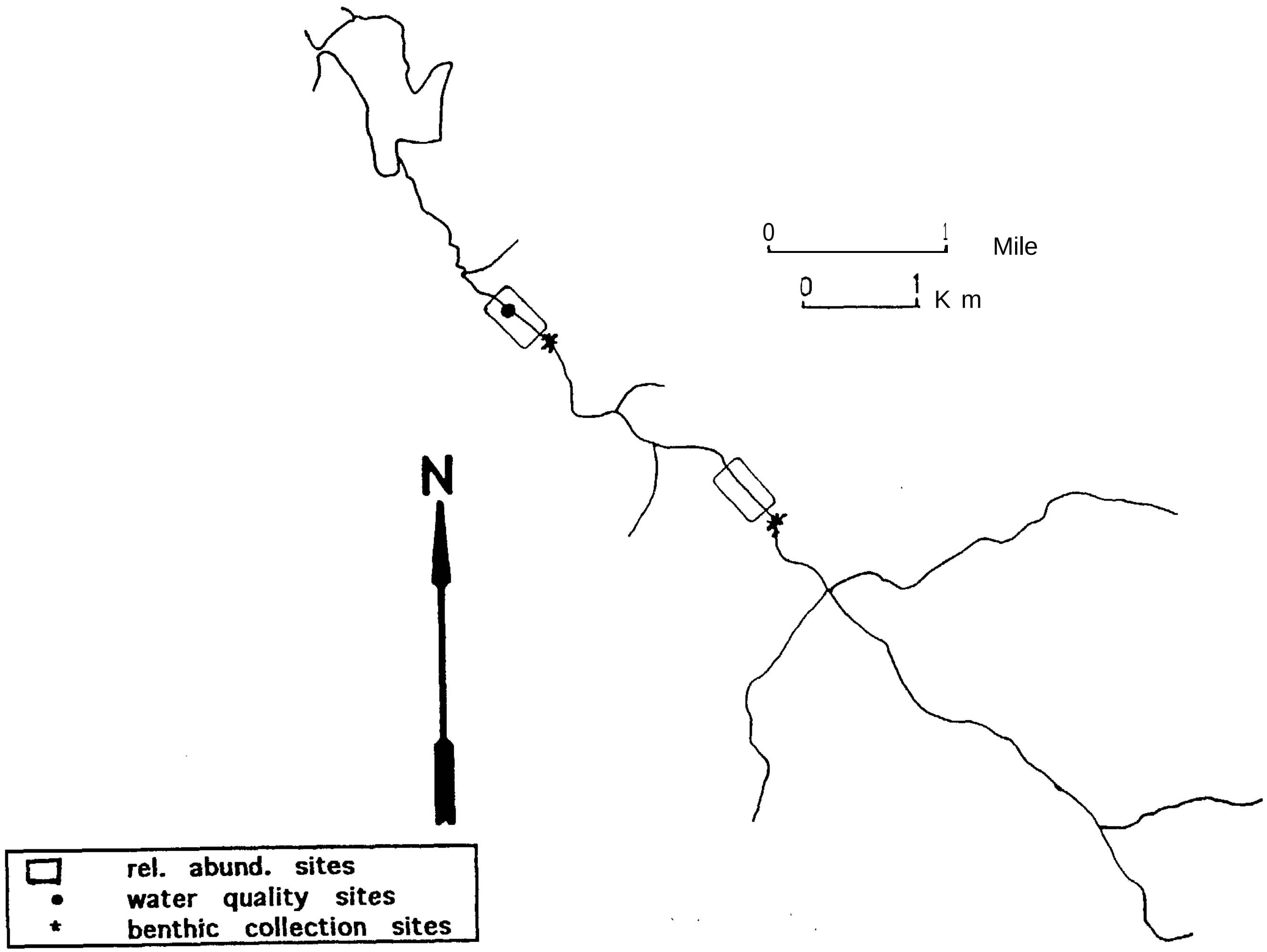

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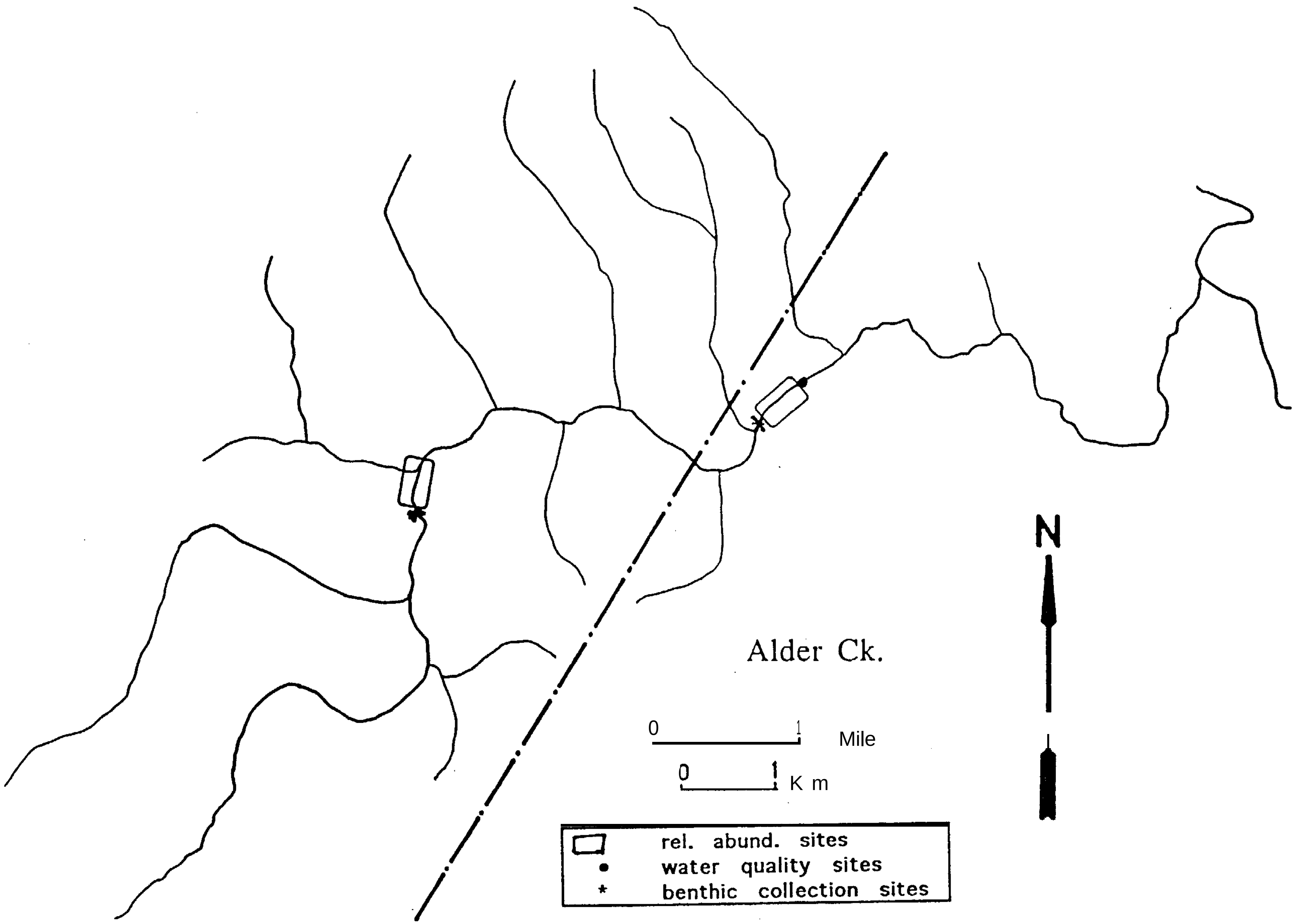

Figure 2.9. Map of Alder Creek showing the locations of the relative abundance, **benthic macroinvertebrates** and water quality stations.

quality parameters were used collectively to measure the variation from an ideal pristine state. Parameter seven was used to estimate a substrate size range that is acceptable for a fish species need.

Seven habitat alteration functions were rated on a scale of zero to one. Habitat alteration functions were intrinsic factors which directly and proportionately affect habitat quality. Each function had the power to reduce habitat quality ratings. These fourteen components (7 parameters and 7 functions) were combined to calculate a habitat quality index. Stream that had HI values between four and seven were considered ideal for enhancement studies, whereas stream reaches with high HI values (i. e. near pristine conditions) did not need enhancement. Streams with low HI values (i.e. severely degraded) were eliminated from further enhancement consideration because cost/benefits were considered prohibitive. The habitat quality index used was:

$$HI = \frac{\sum_{i=1}^{Np}(Pi)}{Np} \times f_1 \times f_2 \times f_3 \times f_4 \times f_5 \times f_6 \times f_7$$

where:	HI	=	Habitat quality index.
	Pi	=	Habitat parameters.
	Np	**=**	The number of parameters used.
	f	=	Habitat functions.

Those values closer to ten were considered more pristine and unaltered, and those closer to one, more altered and degraded.

To assure sampling continuity, habitat quality parameters one through six were estimated by the same field personnel. Parameter seven (substrate suitability) was calculated. Parameters used for this survey are as follows:

<u>Parameter one (Pl) evaluated man-made obstructions.</u> High values were given to those streams that had no manmade obstructions that caused a vertical drop of not more than one foot. Low ratings were given to streams that had one or more structures causing a drop of more than 10 feet during low flows. Rankings were:

P1	Barriers
10	No manmade obstructions to free passage of fish upstream.
8	No dams/structures causing a vertical drop of more than 1 foot during low flow.
5	No dams/structures causing a vertical drop of more than 3 feet during low flow.
3	No dams/structures causing a vertical drop of more than 10 feet during low flow.
0	One or more dams/structures each causing a drop of more than 10 feet during low flow.

Parameter two (P2) estimated the amount of the watershed in urban development. High values were given for a low percent of urban development where as low values were given for a high percentage of urban development. Rankings were:

P2	Urbanization
10	<5% of watershed in urban development.
8	510% of watershed in urban development.
5	1 l-40% of watershed in urban development.
3	4l-70% of watershed in urban development.
0	71-100% of watershed in urban development.

Parameter three (P3) examined the condition of riparian veaetation 50 to 100 feet from each stream bank. High values were assigned to streams that had banks protected by perennial vegetation and excellent canopy cover. Low values were assigned to streams with little perennial riparian vegetation with limited to no canopy cover. Rankings were:

P3	Condition of Riparian Veaetation: (50-100 ft each stream bank)
10	90-100% of banks protected by perennial vegetation with excellent canopy cover.
8	60-89% of banks protected by perennial vegetation with good canopy cover.
5	40-59% of banks protected by perennial vegetation with fair to good canopy cover.
3	10-39% of banks protected by perennial vegetation with limited to fair canopy cover.
0	O-9% of banks protected by perennial vegetation with limited to no canopy cover.

Parameter four (P4) evaluated the condition of the floodplain. High values were given to those streams where little or no evidence of recent active erosion of the floodplain occurred. Low values were assigned to those streams where the floodplain showed signs of severe erosion with a poorly defined stream channel. Rankings were:

P4	Condition of the Floodplain
10	Little or no evidence of active or recent erosion of the floodplain during floods.
7	Some segments show evidence of occasional erosion of the floodplain.
5	All segments show evidence of occasional erosion of the floodplain. Stream channel essentially intact
2	All segments show evidence of erosion of the floodplain. In places the stream channel is poorly defined.
0	Floodplain severely eroded and degraded, stream channel poorly defined with much lateral erosion and much reduced flow capacity.

Parameter five (P5) evaluated the percent of the watershed influenced bv timber or conservation practices. High values were assigned to those streams in which a large percent of the watershed was protected. Low values were assigned to those streams in which a low percentage of the watershed was protected. Rankings were:

P5	Land use of Watershed
10	100% of watershed protected by timber, improved pasture, terraces or other conservation practices.
8	80% protected.
5	50% protected.
3	30% protected.
1	10% protected.

Parameter six (P6) evaluated the percent of the watershed controlled bv irriaation and/or domestic withdrawals. High values were assigned to watersheds with little to no withdrawal, whereas, low values were assigned to watersheds with a high percent controlled by irrigation and/or domestic withdrawals. Rankings were:

P6	Flow Alteration
10	<1% of watershed controlled by irrigation and/or less than 50% of the watershed controlled by domestic withdrawals.
8	l-30% of watershed controlled by irrigations and/or 50-60% of the watershed controlled by domestic withdrawals.
5	30-60% of watershed controlled by irrigation and/or 60-75% of the watershed controlled by domestic withdrawals.
3	60-95% of watershed controlled by irrigation and/or 75-85% of the watershed controlled by domestic withdrawals
0	95-100% of watershed controlled by irrigation and/or greater than 85% of watershed controlled by domestic withdrawal.

Parameter seven (P7) evaluated substrate suitability. **High** values were assigned to those streams with suitable substrates and low values were assigned to those streams that had unsuitable substrate for targeted species of fish. The Wentworth Grade Scale (Table 2.2) was used in classifying sediment sizes. Rankings were:

P_7	Substrate suitability
10	Substrate suitability excellent
7	Substrate suitability acceptable
4	Substrate suitability poor
	Substrate suitability unacceptable

Habitat alteration functions one, two and four through seven were estimated by the same person for continuity. Function number three, water quality, was based on laboratory analysis. The functions evaluated as part of this survey included:

Function one (fl) related channel modification to percent fish reduction. Three types of modifications occurred: (1) Clearing and snagging, which removed instream and bank vegetation; (2) channel realignment, which cut a straight channel and eliminated the old meandering channel, decreasing the streams sinuosity; and (3) channel paving, in which the stream channel is lined with concrete, metal or some other material. Each modification will result in reductions of the fish population. High values were assigned when no channel modification occurred and low values were assigned for greatly modified channels. Rankings were:

f_1	Channel modification
Clearing, Snagging	25% fish reduction
Channel Realignment	80% fish reduction
Channel Paving	(i.e. culverts, 95% fish reduction)
Calculation:	1-(% stream modified X % fish reduction)
	(all %'s expressed as a decimal)

Function two (f2) was evaluated bv examinina stream impoundments. Stream channels that were not impounded had higher values then those streams that were impounded during normal runoff. Rankings were:

Table 2.2. Wentworth grade scale used in classifying sediment sizes (Pettijohn et al. 1973).

Particle name	Size (mm)
Boulder	256
Cobble	64
Pebble	4
Granule	2
Very Coarse Sand	1
Coarse Sand	1/2
Medium Sand	1/4
Fine Sand	1/8
Very Fine Sand	1116
Coarse Silt	1/32

f_2	Impoundment: % degradation 1-(% degradation expressed as a decimal) zero default = 0.01 *i.e* l-l = 0.01
0	Stream not impounded.
30	Stream reach impounded during a 1 in 75 year flood event.
50	Stream reach impounded during a 1 in 50 year flood event.
80	Stream reach impounded during a 1 in 25 year flood event.
100	Stream reach impounded at normal or conservation elevation of impoundment.

Function three (f3) was evaluated on water aualitv. Streams that were considered unpolluted (i. e. below EPA limits) were assigned a higher value than streams that were polluted above EPA standards for the protection of aquatic life (Table 5). Rankings were:

f_3	Water Quality based on EPA criteria
1.0	Stream water unpolluted. No pollutants detected by chemical analysis. Low or no turbidity.
0.8	Occasional above normal levels of one or two water quality constituents usually present, but detectable only by analysis.
0.5	Occasional visible signs of over supply of nutrients very noticeable turbidity.
0.1	Grossly polluted waters for majority of Parameters.

Function four (f4) was evaluated on the amount of unstable material (silt. sand and gravel) that was transported into and throuah an area. High values were given for low to no fine transported material. Low values were given to streams that had great amounts of unconsolidated transported material. Rankings were:

f_4	Streambed Condition
1.0	No apparent unstable material in channel with substrate of bedrock, boulders, rubble, gravel or firm alluvium.
0.9	Traces of unstable silt, sand, or gravel in quiet areas, pools large with firm substrate.
0.8	Quiet areas covered by unstable materials, deep pools restricted to areas with greatest scour.
0.7	Pools shallow, filled with silt, sand or gravel, riffles contain noticeable silt deposits.
0.5	Streambed completely covered by varying thicknesses of transported material such as silt, sand, and gravel.
0.1	Stream channel nearly or completely filled with unconsolidated, transported material; no surface flow except during floods.

Function five (f5) was evaluated on the stream's base flow. High values were given to perrianal streams with water velocities conducive to fish passage. Low values were given to intermittent streams or streams that had water velocities in excess of 6 ft per second and above, which prevented fish passage (Bell 1986). Rankings were:

f5	Flows necessarv for passage
1.0	Flow Year around: No passage problems: Water velocity not to high to prevent passage below 6 ft/sec.
0.75	Flow year around: Minor passage problems due to low or high flows.
0.5	Channel drys up in late summer resulting in significant fish passage problems.
0.25	Channel drys up in late spring preventing fish passage; or water velocity too high for most fish passage.
0.01	Channel drys up in early spring; or water velocity to high for fish passage.

Function six (f6) was evaluated based on hiqh water temoeratures. Streams with water temperatures below 14° C in summer were ranked higher then streams with water temperatures above 20° C. Rankings were:

f6	Water temperature
1.0	Average maximum water temperatures below 14° C in summer.
0.75	Average maximum water temperatures of 15° C in summer.
0.5	Average maximum water temperatures of 17° C in summer.
0.25	Average maximum water temperatures of 19° C in summer.
0.01	Average maximum water temperatures above 20° C in summer.

Function seven (f7) was evaluated based on habitat suitability for all life staaes of cutthroat and bull trout. This was based on the estimated amount of habitat available for each life stage. Suitable cutthroat and bull trout habitat was based on literature review as described in Graves et al (1990). High values are given for good habitat for all life stages, while low values are given for poor habitat for one or more life stages. Rankings were:

f7	Habitat suitabilitv for all life staaes
1	Good habitat for all life stages.
0.6	Poor habitat found for one life stage, limited for other stages, or limited for all life stages.
0.1	Poor habitat found for more than one life stage.

2.2.2. Cursory stream surveys

Ground surveys were initiated in April, 1991 to collect physical information that was used as input data for the above index model. Two field personnel began sampling from the mouth of a stream and continued to move in an upstream direction. Sampling stopped at a point upstream where the stream became too small to contain any trout habitat. Field personnel marked on USGS 7.5 minute topographic maps locations, amounts, and condition of the following physical information:

1.) Lenath of suitable fish habitat
2.) Passaae barriers
3.) Urban development of watershed
4.) Condition of rioarian veaetation
5.) Condition of the floodplain
6.) Land use of watershed
7.) Flow alteration
8.) Channel modification
9.) Imooundments
10.) Streambed condition
11.) Habitat suitability for all life Stages

2.2.3. Stream discharge measurements

Stream discharge was measured monthly using a Price pigmy current meter in conjunction with a top setting wading rod following the methods of Buchanan and Somers (1980). Stream widths were measured and divided into at least 10 equal segments. Velocities were then measured at each cell at two thirds of total depth. Discharge was calculated by the following formula:

$$Q = \sum_{i=1}^{n} \left(\frac{W_{i+1} - W_{i-1}}{2} \right) d_i \left(\frac{V_{i1} + V_{i2}}{2} \right)$$

where:

Q = Total discharge
n = Total number of individual sections
w_i = Horizontal distance from the initial point
d_i = Water depths for each section, and

v_i = Measured velocity for each section.

The estimated maximum spring runoff velocity was then calculated using the Manning Equation (Brooks et *al.* 1991) to determine the validity of function five (f5) in the above habitat quality index. The following formula was used:

$$V = \frac{1.49}{n} Rh^{2/3} S^{1/2}$$

where:

v = The average velocity in the stream cross section (ft/sec).

n = Roughness coefficient as read from Table 3 page Brooks *et al.* (1991).

s = Energy slope as approximated by the down gradient water suface slope (ft/ft).

Rh = Hydraulic radius based on the following formula:

$$Rh = \frac{A}{WP}$$

Where:

A = The cross-sectional area of flow (ft^2), and

WP = Wetted perimeter (ft).

2.2.4. Water quality analysis

Water samples were collected seasonally to determine water quality. Tests for conductivity, dissolved oxygen, pH and temperature were conducted in the field using a Surveyor model two Hydrolab. Water samples were also collected for laboratory analysis of nitrate, nitrite, phosphates, and alkalinity using a LaMotte Chemical calorimetric test kit. Total dissolved solids were determined using a HANNA model 0661-l 0 dissolved solids tester. Total suspended solids were determined using the methods reported in Standard Methods For the Examination of Water and Waste Water (APAH 1985).

2.2.5. Substrate analysis

Substrate samples were collected in segments of each creek that showed potential spawning sites for cutthroat and bull trout to determine the amount of sediment deposition and to evaluate fry production. A freeze core sample was used following procedures described by Walkotten (1976). Samples were placed in bags and transported to the laboratory for analysis. After drying, each sample was sorted into categories using a series of 13 sieves.

Material retained on each sieve was weighed and the percent dry weight in each size class was calculated (Driscoll, 1986). The data was then used to estimate the quality of the sampled substrate for trout reproduction. A spawning substrate quality index developed by Lotspeich and Everest (1981) which overcomes limitation of other indices have been used to assess substrate quality (Platts *et a/* 1979). The procedure uses a measure of the central tendency of the distribution of the sediment particle sizes in a sample and the dispersion of particles in relation to the central value to characterize the suitability of the substrate for salmonid spawning, incubation and emergence. These two parameters were combined to develop a "Fredle index" (f) of substrate quality according to Platts *et a/* (1983). The formula used was;

$$fe = \frac{d_g}{S_o}$$

where:

fe	=	Fredle index
S_o	=	Sorting coefficient,
d_g	=	Mean grain size based on the following formula:

$$dg = (d_1^{w1} \times d_2^{w2} \times \ldots dnwn)$$

where;

dg	=	mean grain size
dn	=	the diameter at selected weights
w	=	weight at a selected diameter
s o	=	Sorting coefficient based on the following formula,

$$So = \frac{d_{75}}{d_{25}}$$

where:

d_{75}, d_{25}	=	particle size diameters at which either 75 or 25 percent of the sample is finer on a weight basis.

This index will give an indication of sediment permeability and pore size which are the two most influential factors governing salmonid embryo survival-to-emergence (Platts et al, 1983). With this index, substrate quality can be compared before and after habitat improvements are made. Values for substrate suitability range from O-10. Values ranging from four or less are poor substrate suitability, while values between seven and ten are acceptable to excellent substrate values.

2.3. FISHERIES SURVEYS

2.3.1. Relative abundance

Fish relative abundance was determined by electrofishing using a Smith-Root Type VII pulsed-DC backpack electrofisher. Tributaries were sampled five days in June and August and six days in October. Tributaries were divided into lower, middle and upper sections to represent the longitudinal variation in habitat. In June, three concurrent three hundred foot sections were selected within each reach. In August and October two or three two hundred foot sections were electrofished within each reach depending on the length of the reach. Each section was electrofished using the standard guidelines and procedures described by Reynolds (1983). Fish captured were identified, enumerated, and measured to the nearest millimeter. A scale sample was removed from all salmonid species for age and growth determination.

2.3.2. Population estimates

Cutthroat and bull trout populations were estimated in tributaries streams in October, 1991 using the removal-depletion method (Seber and LeCren 1967, Zippen 1958).

The streams were divided into lower, middle and upper section. Four to six, two-hundred foot sections were randomly selected, depending on the length of the stream, to represent the longitudinal variation in habitat of each tributary. Blocknets were placed at the upstream and downstream boundaries to prevent immigration and emigration. Each section was electrofished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected by using a Smith-Root Type VII pulsed-DC backpack electrofisher. A minimum of two electrofishing passes were made for each two hundrend foot section. Fish captured in the first pass were held in buckets until the second pass was made. Captured fish were identified, enumerated, measured to the nearest millimeter and some were tagged with a Floy FD-6B numbered anchor tag. Scales were removed and a weight measurement was taken from a representative group of each target species for age and growth determination.

For each reach in which two passes were made, the population was estimated using the following equation of Seber and LeCren (1967):

$$N = \frac{(U_1)}{(U_1 - U_2)},$$

Where: N = estimated population size;
U_1 = number of fish collected in the first pass; and,
U_2 = number of fish collected in the second pass

The standard error of the estimate was calculated by:

$$S.E.(N) = \sqrt{\frac{(U_1)^2 (U_2)^2 T}{(U_1 - U_2)}}$$

where: S.E.(N) = standard error of the population estimates; and

T = total number of fish collected $(U_1 + U_2)$

When three or more passes were made in the section, the population was estimated using the methods of (Zippin 1958). The first number needed was calculated where:

$$T = \sum_{i=1}^{n} (U_i),$$

where: T = total number of fish collected
Ui = number of fish collected in the ith removal; and
n = the number of removals

The ratio (R) was then calculated using the equation:

$$R = \frac{\sum_{i=1}^{n} (i-1) U_i}{T}$$

The population estimate (N) was then calculated using the equation:

$$N = \frac{T}{Q}$$

where: Q = the proportion of fish captured during all passes. Q was located by using the ratio (R) on the curve found in Fig. 22 of Platts et al. (1983).

The standard error of the estimate was calculated by:

$$S.E.(N) = \sqrt{\frac{N(N-T)}{T^2 - N(N-T)\frac{(kP)^2}{(1-p)}}}$$

where: P = The estimated probability of capture during a single removal and is found using the ratio (R) on the curve found in Fig. 23 of Platts *et al.* (1983).

The 95 percent confidence intervals were placed around the estimate by multiplying the standard error by 1.96.

2.3.3. Age, growth and condition

Scale samples were collected by following methods of Jearld (1983). In the laboratory, several scales were mounted between two glass microscope slides and viewed using a Realist, Inc., Vantage 5 microfiche reader. The age was determined by counting the number of annulli (Lux 1971, Jearld 1983). Simultaneous to age determination, measurements were made from the center of the focus to the furthest edge of the scale. Along this line, measurements were made to each annulus. The measurements were made to the nearest millimeter under a constant magnification. Annual growth was then back-calculated using the Lee method as described by Carlander (1981). This method involved the use of the formula:

$$L_i = a + \left(\frac{(L_c - a)}{S_c}\right) S_i,$$

where:	Li	=	Length of fish (in mm) at each annulus;
	a	=	intercept of the body scale regression line;
	Lc	=	length of fish (in mm) at time of capture;
	SC	=	distance (in mm) from the focus to the edge of the scale; and
	Si	=	scale measurement to each annulus.

The intercept (a) was obtained from the regression analysis of body length -v- scale length at time of capture. The number of fish in each age class were equalized before the regression analysis of the body length-scale length was conducted. This was accomplished by randomly selecting an equal number of fish from each age class. If an age class was represented by only a few fish then all were used. It was felt that this method yielded a more reliable intercept value since the regression line was not biased by strong year classes. The regression analysis was accomplished using StatView 512+ on a Macintosh SE computer.

The proportional method of back-calculation was used for some species when small sample sizes led to poor regressions. The following equation was used:

$$Li = \frac{Si}{Sc} Lc$$

This formula does not take into account the size of fish at scale formation as does the Lee method.

Condition factors were computed as an indicator of the fishes growth pattern and, therefor, an indication of its general condition (Everhart and Youngs 1981). The formula to calculate the condition factor is:

$$K_{tl} = \left(\frac{W}{L^3}\right) 10^5$$

Where:	K_{tl}	=	condition factor;
	w	=	weight of fish in grams; and
	L	=	total length of fish in millimeters.

Comparisons were made to condition factors in other streams in the Pacific Northwest.

2.3.4. Creel survey

The Coeur d'Alene creel survey was designed to:

1. Estimate total angler effort (pressure) in selected tributaries.
2. Determine catch-per-unit effort (CPUE) in selected tributaries.
3. Estimate the annual harvest (catch) for each species in selected tributaries.
4. Determine mean size, weight, and biomass of fish caught by anglers.

The study section was divided into three main areas. The sections included all those tributaries located in the northeast, southeast and northwest sections. The days in the month were divided into weekdays and weekend days (including holidays). The day was then divided into two time periods, AM and PM. The AM time period went from sunrise to 1 PM. The PM time period went from 1 PM to sunset.

During each AM and PM creel period, two randomly timed progressive angler pressure counts were conducted. These pressure counts were made by automobile with the direction of travel randomly selected. Creel clerks began at one of a section and worked either north or south until all tributaries had been surveyed. The number of anglers within the section was recorded. As the season progressed and tributaries went dry the four selected tributaries were targeted more heavily. Only occasionally progressive angler counts were conducted on all selected creel locations.

Angler interviews were conducted to obtain information about the number of anglers, the total number of hours fished, the species of preference, and the number of each species caught and kept or released.

Creel clerks examined all fish (if possible) caught by surveyed anglers, to obtain the species, length, weight, sex, and removed a scale sample for age determination.

Pressure was estimated monthly for each tributary, day type, and time period (stratum) by the formula:

$$PE_s = \left(\frac{N_s}{n}\right)(X_s)\ (H_a)$$

Where:

PE_s = pressure estimate for each stratum per month:

N_s = number of hours within each stratum per month;

$$N_s = (D_s)(H_d)$$

Where:

N_s = number of hours for each stratum per month:
D_s = number of days per month within the stratum; and
H_d = average number of hours per day for each stratum per month.*

n = number of hours sampled for each stratum per month;

X_s = mean number of anglers for each creek per month;

$$X_s=(X_d)(D_s)$$

Where:

X_s = mean number of anglers for each stratum per month;

X_d = mean number of anglers for each stratum per day; and

D_s = number of days per month within the time period.

and ,

Ha = mean number of angler hours per angler for each creek per month.

$$Ha = \left(\frac{T_h}{A_i}\right)$$

Where:

Ha = mean number of angler hours per angler for each stratum per month;

T_h = total hours spent fishing for each stratum per month; and

A_i = total number of anglers interviewed for each stratum per month.

The variance of the pressure estimate for each stratum per month was calculated by:

$$VPE_s = \left(\frac{N_s}{n}\right)S_s^2$$

where:

VPE_S = variance of pressure estimate for each stratum per month;

N_S = number of hours for each stratum per month;

n = number of hours sampled for each stratum per month; and

S_S = standard deviation of mean number of angler hours for each stratum per month.

Ninety-five percent confidence intervals for each stratum per month were calculated by:

$$C.I. = PE \pm \sqrt{VPE_S} \times 1.96$$

where: C.I. = 95% confidence intervals for each stratum per month;

PE = pressure estimate for each stratum per month; and

VPE_S = variance of the pressure estimate for each stratum per month.

Monthly angler pressure and 95% confidence intervals were calculated by summing the four stratum values for angler pressure and summing the 95% confidence intervals.

Catch per unit effort (CPUE) was calculated for each species of fish caught, whether the fish was kept or released, and for each species of fish caught and kept. CPUE was calculated for individual tributaries by dividing the number of fish caught by the number of hours spent fishing by interviewed anglers at that tributary.

Harvest of fish species was estimated by multiplying the CPUE times the pressure estimate.

2.4. MACROINVERTEBRATE SURVEYS

2.4.1. Benthic macroinvertebrates

Benthic macroinvertebrate densities were collected using the methods of Waters and Knapp (1961). A modified hess sampler, with an area of 0.1 m^2, and a net aperture of 390 μm, was pushed approximately 10 cm into the substrate at three sites across the width of the stream. Stones found in the area were removed and cleaned of all attached material. The substrate was then disturbed by stirring to obtain any remaining macroinvertebrates. The sample was then preserved in 10 percent formalin.and transferred to a 70% alcohol solution in the lab. Samples were collected in the same areas as the fish collections for feeding habits studies during all three sampling months.

2.4.2. Drift macroinvertebrates

Two drift samples were collected upstream from fish electroshocking areas in each tributary during each sampling month. Water depth was measured using a wading rod, while velocity measurements were measured directly in front of the sampler at 0.6 of the water depth, using a Price Pygmy current meter (Buchanan and Somers,1980). These measurements allowed for the calculation of densities of organisms per volume of water passing through the drift. All samples were preserved in the field using 10 percent formalin and transferred to a 70% alcohol solution in the lab.

2.4.3. Shannon-Weiner diversity index

To determine if a stream was healthy or unhealthy the Shannon-Weiner diversity index was used (Perkins 1982). With this method the number of species as well as the number of individuals within each species are taken into account (Krebs 1985). The lowest value would be obtained when only one species is represented in a stream. The highest value would be obtained when each species is represented by equal numbers of individuals.
This equation was:

$$H = -\sum_{i=1}^{s} (p_i)(\log_2 p_i),$$

where: H = Index of species diversity;
S = Number of species; and
p_i = Proportion of total sample belonging to the ith species.

Values above three represent high diversity and normally indicates a healthy unpolluted community. A low diversity of less than two usually indicates an unhealthy and possibly polluted community (Herricks and Cairns 1974). Densities and diversities were then compared to other area streams.

3.0 RESULTS

3.1. HABITAT EVALUATION

3.1.1. Habitat Quality Indices based on ground surveys

Habitat quality index values range from 0 to 10. Index values of O-3 are regarded as severely degraded tributaries, while values of 3-7 are regarded as moderately degraded but enhancable. Values of 7 and above are good to pristine and require little to no en hancement work.

Habitat quality index values ranged from 0.02 for Bellgrove Creek to 5.52 for Alder Creek (Table 3.1). Values for Bellgrove, Hells Gulch, Squaw, Fighting, Plummer and Little Plummer creeks were all below one. Benewah, Lake, Evans and Alder creeks had index values ranging from 3.04 for Benewah Creek to 5.52 for Alder Creek. For a complete explanation of individual parameter and function descriptions and values for each tributary see Appendix A.

The index value for Bellgrove Creek was the lowest of all habitat index values at (0.02). Factors that contributed to this HI value include one large obstruction, degraded riparian zones, erosion of the stream channel banks, poor land use practices, and unacceptable substrate suitability. Other factors include minor channel modifications, high turbidity, and a high percent of silt. Low base flow in the summer along with high water temperatures contribute to poor habitat for all life stages and a low index value.

A habitat index value of 0.19 was calculated for Fighting Creek. Reasons for this low HI value were; a large concrete bridge which resulted in a passage barrier; channel erosion; degraded riparian zones and poor land use in 40 percent of the watershed and unacceptable substrate suitability. Heavy silt loads, low base flow in the late summer, high water temperatures and limited habitat for all life stages also influenced the habitat index value.

An index value of 0.05 was calculated for Hell's Gulch. Factors that contributed to this value were passage barriers in the form of two culverts; one at the mouth and, another one mile upstream. Poor substrate suitability, channel realignments, midstream impoundments during a 1 in 50 year flood event, low base flow in

Table 3.1. Habitat quality index values for tributaries located within the Coeur d'Alene Indian Reservation.

Stream name	H.I. value	Reason
Bellgrove Creek	**0.02**	barrier, degraded riparian zones, channel erosion, land use practices, unsuitable substrate, water quality,high H20 temp., overall poor habitat for all life stages.
Fighting Creek	**0.19**	Barrier, degraded riparian area, channel erosion, land use, unsuitable substrate, heavy silt loads, low base flow, high H20 temp., limited habitat for all life stages.
Hell's Gulch Creek	0.05	culverts, unsuitable substrate, channel realignment, flow alterations, intermittent conditions, high H20 temp. and poor habitat for all life stages
ɔw ıll life stages.	**Squaw Cree**	erosion, land use, unsuitable substrate, **; 0.08** base flow, poor habitat for
Plummer Creek	0.42	Channel erosion, land use, unsuitable substrate, heavy silt loads, low base flow, high $H_2$0 temp poor adult habitat and limited habitat for other life stages.
L. Plummer Creek	**0.71**	Culverts, degraded riparian zones, channel erosion, land use, unsuitable substrate, high silt loads, passage problems, high h20 temp., no adult habitat and limited habitat for other life stages.
Benewah Creek	3.04	Degraded riparian zones, channel erosion, land use, minor passage problems and high $H_2$0 temp.
Lake Creek	**3.12**	Land use, unsuitable substrate, water quality problems, high silt loads and high water temp.
Evans Creek	**4.93**	Degraded riparian zones, channel erosion, land use, high turbidity
Aider Creek	5.52	Bank stability, land use, high water temp.

late spring, and high water temperatures contribute to poor habitat for all life stages and a low index value.

Squaw Creek received an HI value of 0.08. Parameters that contributed to this value were; occasional erosion of the stream channel; poor land use in 30 percent of the watershed and poor to unacceptable substrate suitability . Low base flow in the early spring and poor habitat for all life stages resulted in a low habitat index value for Squaw Creek.

Plummer Creek received a habitat index value of 0.42. Contributing factors included channel erosion, poor land use in 50 percent of the watershed and unacceptable substrate suitability. Other factors included high siltation rates in the headwaters, low base flow in early summer, high water temperatures and poor habitat for adults and limited habitat for other life stages.

Little Plummer Creek had a habitat index value of 0.71. Parameters that contributed to this HI value were; one large obstruction, degraded riparian zones in 50 percent of the watershed, occasional stream channel erosion, poor land use in 30 percent of the watershed, and poor to unacceptable substrate suitability. Other factors for the habitat index value include high silt concentrations in quiet areas of the stream, low base flow causing passage problems, high water temperatures and poor habitat for adults and limited habitat for other life stages.

A habitat index value of 3.04 was calculated for Benewah Creek. Degraded riparian zones in 40 percent of the watershed, occasional channel erosion, poor land use in 40 percent of the watershed all contributed to the habitat index value. Other factors included minor passage problems due to low base flow and seasonally high water temperatures.

Lake Creek received an index value of 3.12. Parameters that contributed to this value were; poor land use in 40 percent of the watershed, and poor to unacceptable substrate. Other factors included high turbidity, low pH , high silt percentages in sections of the stream, and and high water temperatures.

A habitat quality index value for Evans Creek was calculated at 4.93. Parameters that contributed to this HI value were; degraded riparian zones along 50 percent of the stream, stream channel erosion in the lower segment, poor land use practices in 50 percent of the watershed, and site-specific substrate problems. Other factors included high turbidity during runoff events, and minor traces of silt in the stream bed.

Alder Creek had the highest habitat index value at 5.52. Minor problems in the upper stream drainage were encountered because of stream bank protection and land use practices. Higher than desirable water temperatures were also observed.

3.1.2. Stream discharge measurements

Discharge measurements were collected monthly from May, 1991 to October, 1991. Measurements were made the last week of the month for all months. Monthly discharge measurements for each creek are found in Table 3.2. May discharge measurements ranged from .36 cfs for Squaw Creek to 61.28 cfs for Benewah Creek. June discharge measurements ranged from 2.91 cfs for Hell's Gulch to 12.75 cfs for Alder Creek. Squaw Creek was intermittent by June and no discharge measurement could be made. Plummer Creek had the least discharge measurement for July at 1.72 cfs, while Evans Creek had the most discharge at 7.33 cfs. In August Fighting/Bellgrove Plummer, Little Plummer and Hell's Gulch were intermittent therefore, no discharge measurements were made. Evans Creek had the highest discharge measurement in August at 3.28 cfs, while Benewah Creek had the lowest measurable discharge at 1.88 cfs. In September, Benewah had the highest discharge measurement at 3.66 cfs, followed by Lake Creek at 3.38 cfs. In October, Benewah also had the highest discharge measurement at 4.30 cfs, followed by Evans at 3.50 cfs. Figure 3.1 and 3.2 shows the monthly discharge profiles for all tributaries.

3.1.3. Water quality analysis

Water quality data was collected seasonally in May, August and October. Temperature profiles were collected monthly from May to October. Spring water quality parameters (ppm) for alkalinity ranged from 10 ppm to 80 ppm for Alder and Plummer creeks respectively. Nitrite values ranged from 0.00 ppm for Hell's Gulch to .06 ppm for Squaw Creek. Nitrate values ranged from 0.00 ppm for Fighting/Bellgrove, Lake, Benewah and Alder creeks, to 0.13 ppm for Plummer and Evans creeks. Phosphate values ranged from 0.00 ppm

Table 3.2. Monthly discharge measurements in cubic feet per second (cfs) for selected Coeur d'Alene tributaries.

Stream	Discharge (cfs)					
	May	June	July	August	September	October
Fighting/Bellgrove	11.58	6.82	2.09	*	*	*
Hell's Gulch	51.27	2.91	3.06	*	*	*
Squaw	0.36	*	*	*	*	*
Mainstem Plummer	20.32	4.66	3.11	*	*	*
Little Plummer	16.09	4.50	1.72	*	*	*
Benewah	61.28	7.19	6.73	1.88	3.66	4.30
Lake	27.87	11.09	5.69	1.9	3.38	2.37
Evans	48.96	9.22	7.33	3.28	1.89	3.50
Alder	35.82	12.75	4.37	3.0	1.85	1.48

• intermittent conditions existed therefore, no samples were collected.

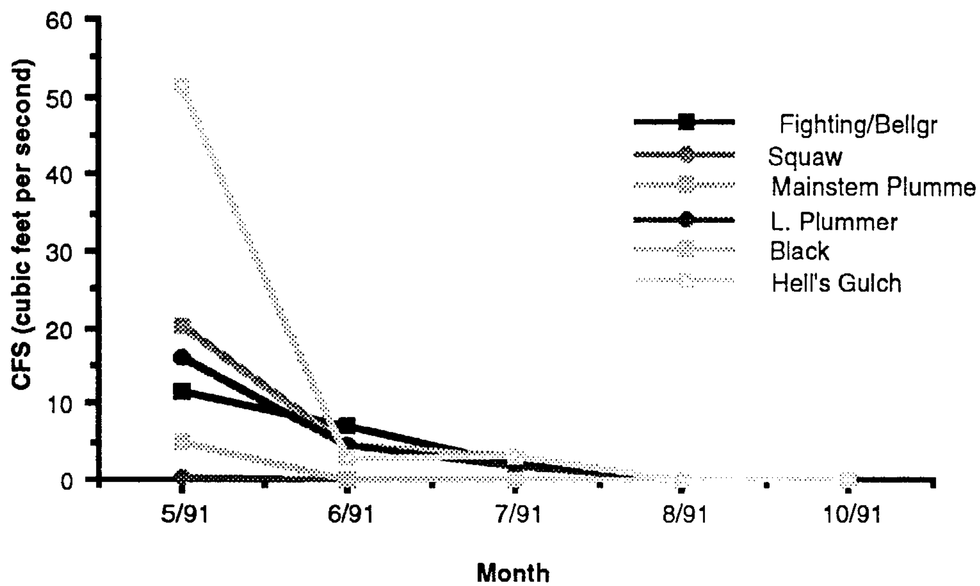

Figure 3.1 **Monthly discharge profiles for non-primary tribuataries located on the Coeur d'Alene Indian reservation during 1991.**

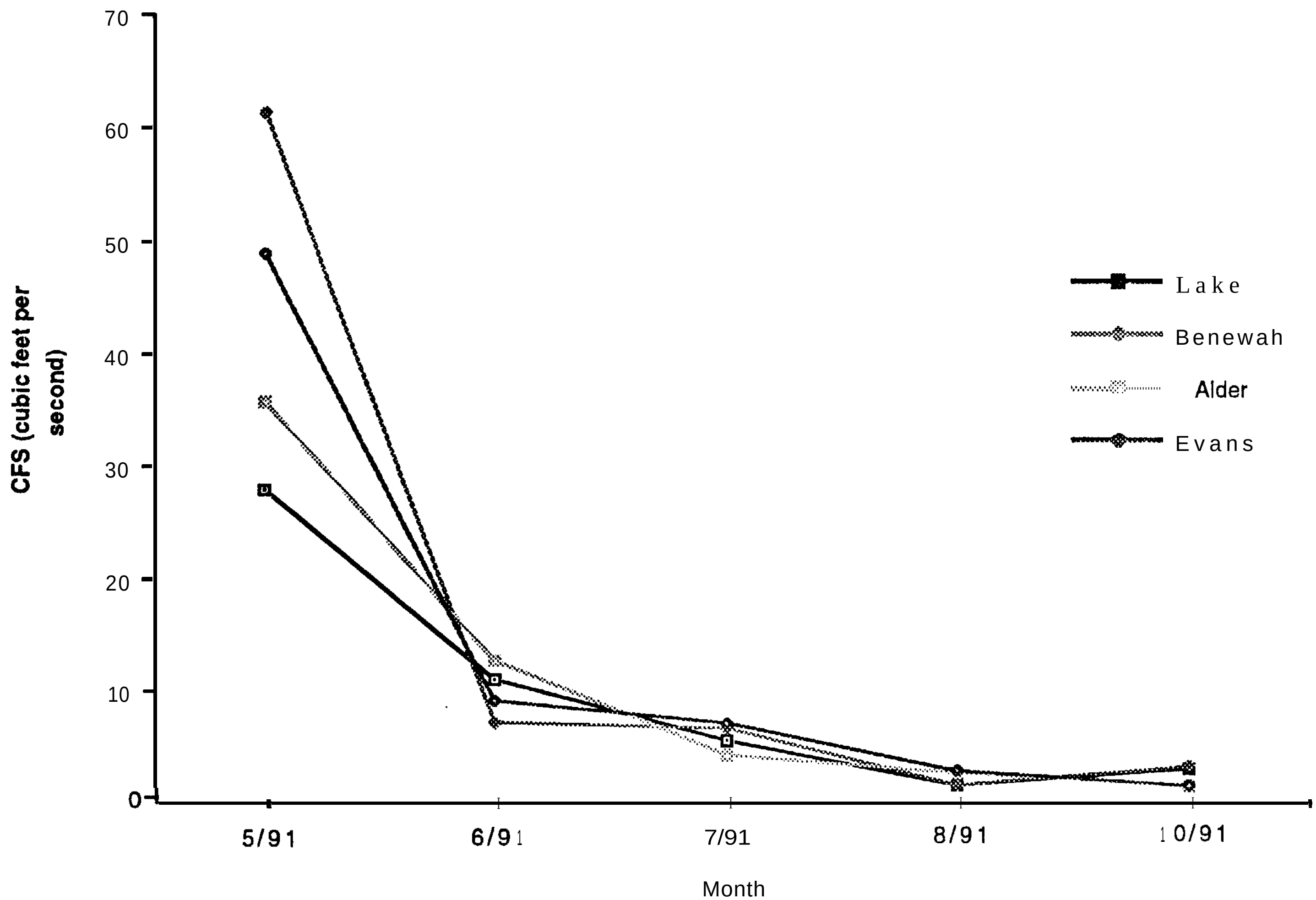

Figure 3.2 Monthly discharge profiles for primary tributaries located on the Coeur d'AleneIndian Reservation during 1992

for Lake Creek to 1.24 ppm for L. Plummer Creek. Total dissolved solids were below 10 ppm for all tributaries sampled (Table 3.3). Conductivity values ranged from .005 μmhos for Fighting/Bellgrove Creek to .058 μmhos for L. Plummer. PH values ranged from 4.8 for Lake Creek to 8.5 for Evans Creek. Dissolved oxygen values ranged from 6.5 mg/l for Lake Creek to 14.2 mg/l for Benewah Creek (Table 3.4).

Summer water quality values for alkalinity ranged from 20 ppm for Hell's Gulch to 60 ppm for Plummer and Alder creeks. Nitrite values ranged from .OO ppm for Plummer, Hell's Gulch and Evans creeks, to .10 for L. Plummer Creek. Nitrate values were 0.00 ppm for all tributaries sampled. Phosphate values ranged 0.00 for Evans Creek to 1.11 ppm. Total dissolved solids for all tributaries was below 10 ppm (Table 3.3). Conductivity values ranged from .004 μmhos for Plummer Creek to .032 μmhos for L. Plummer Creek. PH values ranged from 6.2 for Lake Creek to 7.4 for Evans Creek. Dissolved oxygen values ranged from 4.6 mg/l for Fighting/Bellgrove to 16.8 for L. Plummer Creek (Table 3.4).

Fall water quality values for alkalinity ranged from 30 ppm for Evans Creek to 50 ppm for Lake, Benewah and Alder creeks. Nitrite values ranged from 0.0 for Lake and Benewah creeks to 0.03 ppm for Alder Creek. Nitrate values ranged from 0.00 for Alder, Evans, and Benewah creeks to 0.09 ppm for Lake Creek. Phosphate values ranged from 0.00 ppm for Evans and Alder creeks to 0.07 ppm for Benewah Creek. Total dissolved solids for all sampled tributaries were below 10 ppm (Table 3.3). Conductivity values ranged from .034 μmhos for Evans Creek to .089 μmhos for Alder Creek. PH values ranged from 7.0 for Lake Creek to 8.0 for Benewah Creek. Dissolved oxygen values ranged from 11.8 mg/l for Lake Creek to 14.9 mg/l for Benewah and Evans creeks (Table 3.4).

Monthly temperature profiles are provided in Table 3.5. Temperatures in May ranged from 8° C for L. Plummer Creek to 12° C for Squaw Creek. June temperatures ranged from 7°C for Evans Creek to 21 .1 °C for Lake Creek. July temperatures ranged from 12.2°C for Evans Creek to 18.8°C for Plummer Creek. Temperatures in August ranged from 13°C for Evans Creek to 20.9°C for Lake Creek. September temperature ranges were between 15°C for Evans Creek to 24°C for Benewah Creek. October temperature ranges were between 0.3°C for Lake Creek to 2.1°C for Evans Creek.

Table 3.3. Seasonal water quality parameters in parts per million (ppm) for selected Coeur d'Alene tributaries.

	SPRING					SUMMER					FALL				
	Alk.	No_2	No_3	Po_4	TDS	Alk.	No_2	No_3	Po_4	TDS	Alk.	No_2	No_3	Po_4	TDS
M. Fight/Bell.	35	.02	.oo	.95	<IO	40	.01	.oo	.18	<IO					
Hell's Gulch	40	.oo	.04	.23	<10	20	.oo	.oo	.la	<IO					
Squaw	45	.06	.04	.36	<IO	-					-	-	-	-	-
Plummer	80	.04	.13	.58	<IO	60	.oo	.oo	.la	<IO	-	-	-	-	-
L. Plumer	25	.04	.04	1.24	<IO	50	.IO	.oo	.07	<IO	-		-	-	
Benewah	40	.04	.oo	.70	<10	35	.OI	.00	.18	<IO	50	.00	.oo	.07	<10
Lake	40	.03	.oo	.oo	<IO	25	.01	.00	1.11	<IO	50	0.0	.09	.01	c10
Evans	40	.03	.13	.07	<IO	30	.oo	.oo	.oo	<IO	30	.01	.oo	.00	<10
Alder	10	.OI	.oo	.32	<IO	60	.01	.oo	.27	<10	50	.03	.oo	.oo	<IO

\- no sample cc ected

Table 3.4. **Seasonal hydrolab water** quality parameters for selected Coeur d'Alene **tributaries.**

	SPRING			SUMMER			FALL		
	Cond.	pH	D.O.	Cond.	pH	D.O.	Cond.	pH	D.O.
M. Fight/Bell.	.005	5.2	8.6	.024	7.2	4.6	-	-	-
Hell's Gulch	.025	8.0	14.0	.006	6.7	15.2	-	-	-
Squaw	.038	7.5	11.6	-	-	-	-	-	-
Plummer	.005	7.4	10.6	.004	6.5	8.8	-	-	-
L. Plummer	.058	8.3	12.0	.032	6.6	16.8	-	-	-
Benwah	.046	8.2	14.2	.007	6.3	16.4	.071	8.0	14.9
Lake	.005	4.8	6.5	.016	6.2	a.5	.041	7.0	11.8
Evans	.025	8.5	13.9	.006	7.4	a.9	.034	7.9	14.9
Alder	.041	a.3	11.4	.006	6.4	10.8	.089	7.9	14.6

\- no samples were collected

Table 3.5. **Monthly temperature** profiles in degrees Celsius for selected Coeur **d'Alene tributaries** from May,1 991 through October,1 991.

Stream name	May	June	July	August	September	October
Fighting/Bellgrove	8.5	20	15	*	*	*
Hell's Gulch	10	15.6	15.5	*	*	*
Squaw	12	*	*	*	*	*
Plummer	10	20.1	18.8	*	*	*
Little Plummer	8	20.1	13.8	*	*	*
Benewah	9	16.7	16.6	18	24	1.2
Lake	11	21.1	16	20.9	22.9	0.3
Alder	9	16.1	15	15.9	19	0.6
Evans			12.2			2.1

@ Water temperatures were collected the last week of the month.

- Intermittent conditions existed

3.1.4. Substrate analysis

A limited number of substrate samples were collected in segments of each creek in which potential spawning sites for cutthroat and bull trout were observed. The fredle index was calculated for each segment of creek sampled (Table) The fredle index is a measure of pore size and relative permeability both of which increase as the index number becomes larger. The larger the value of the number, the higher the expected emergence survival. Values for Fighting Creek ranged from 0.57 for Upper Fighting to 3.47 for Lower Fighting. Values for the Plummer system ranged from 0.44 for middle Little Plummer to 6.74 for upper Little Plummer. Index values for Evans ranged from 3.93 for Upper Evans to 5.52 for middle Evans. Fredle index values for Alder Creek were 7.25 for both upper and middle segments. Index values for Lake Creek ranged from 1.99 for Middle Lake to 4.83 for Upper Lake. Values for Benewah Creek ranged from 2.16 for Middle Benewah to 4.43 for Lower Benewah.

3.2. BIOLOGICAL EVALUATION

3.2.1. Relative Abundance

In June, August, and October, 1991, a total of 50.34 electroshocking hours were spent collecting relative abundance information. A total of 6,138 fish were collected from eight tributaries. For a complete breakdown of relative abundance data reference Appendix (B).

In June, 1991 a total of 21 hours were spent electroshocking for a total catch of 2,161 fish from eight selected tributaries (Table 3.7). A total of 254 fish were captured from Alder Creek in June. Of the 254 fish collected, 3 (1.2%) were cutthroat trout, 61 (24.0%) were eastern brook trout, 184 (72.4%) were sculpin *spp.* and 6 (2.4%) were longnose sucker (Table 3.8). Table 3.9 shows the breakdown of electrofishing relative abundance data for salmonid species by age class in Alder Creek. Fish were assigned an age based on their length using the back-calculated lengths at the end of each years growth (see section 3.2.3). Of the three cutthroat trout captured in Alder Creek during June, one (33.3%) was age 2+ and two (66.7%) were age 3+. Five (8.2%) of the eastern brook trout were 0+ of age, 38 (62.3%) were I+ of age, 14 (23.0%) were 2+ of age and four (6.6%) were 3+ of age.

Table 3.6. Fredle index values for selected Coeur d'Alene tributaries during 1991.

Creek	Mean grain size (mm)	Sorting coefficient	Fredle index
Lower Fighting	4.85	1.4	3.47
Upper Fighting	0.80	1.4	0.57
Middle Little Plummer	1.40	3.2	0.44
Main Stem Plummer	2.30	1.1	2.07
Little Plummer (Above Confluence)	8.90	1.3	6.74
Upper Benewah	4.21	1.3	3.16
Middle Benewah	3.01	1.4	2.16
Lower Benewah	4.43	1.0	4.43
Lake	6.87	1.4	4.83
Middle Lake	2.65	1.3	1.99
Upper Evans	4.91	1.3	3.93
Middle Evans	7.85	1.4	5.52
Upper Alder	10.30	1.4	7.25
Middle Alder	9.06	1.3	7.25

Table 3.7. Number of each species of fish caught by electrofishing at each Coeur **d'Alene** tributary in June,1 991.

Species	Alder	Benewah	Evans	Fighting	Hell's Gulch	Lake	Plummer/ L. Plummer
Shock time (min)	**154.9**	**326.3**	**137.9**	**56.9**	**58.6**	**154.9**	**366**
Cutthroat trout	3	15	30	27	1	3	4
Eastern brook trout	61	3			8		5
Sculpin *spp*	184	34	206			114	89
Longnose sucker	6	23		2			10
Pumpkinseed		6					
Redside shiner		183				21	44
Northern squawfish		4					4
Dace *spp.*		362				33	677
Yellow perch		1					
TOTAL	**254**	**631**	**236**	**27**	**9**	**171**	**833**

Table 3.8. Percent of each species of fish caught by electrofishing at each Coeur d'Alene tributary in June,1 991.

Species	Alder	Benewah	Evans	Fighting	Hell's Gulch	Lake	Plummer L. Plummer
Shock time (min)	**154.9**	**326.3**	**137.9**	**56.9**	**58.6**	**154.9**	**366**
Cutthroat trout	1.2	2.4	12.7	93.1	11.1	1.7	.5
Eastern brook trout	24.0	.5			88.8		.6
Sculpin *spp*	72.4	5.4	87.3			66.7	10.7
Longnose sucker	2.4	3.6		6.9			1.2
Pumpkinseed		1.0					
Redside shiner		29.0				12.3	5.3
Northern squawfish		.6					.5
Dace *spp.*		57.4				19.3	81.3
Yellow perch		.2					

Table 3.9. Breakdown of electrofishing relative abundance for salmonid species by age class in Alder Creek, 1991.

Age	Cutthroat trout 6/91	Cutthroat trout 8/91	Cutthroat trout 10/91	Eastern brook trout 6/91	Eastern brook trout 8/91	Eastern brook trout 10/91
o+				5 (8.2)	20 (20.6)	10 (8.5)
l+				38 (62.3)	32 (33.0)	52 (44.1)
2+	1 (33.3)	3 (33.3)	6 (33.3)	14 (23.0)	3 5)36.1	37 (31.4)
3+	2 (66.7)	6 (66.7)	12 (66.7)	4 (6.6)	10 (10.3)	19 (16.1)

Table 3.10. Breakdown of electrofishing relative abundance for salmonid species by age class in Benewah Creek, 1991.

Age	Cutthroat trout 6/91	Cutthroat trout 8/91	Cutthroat trout 10/91
o+		6 (46.2)	5 (14.7)
l+		1 (7.7)	16 (47.1)
2+	3 (20.0)	4 (30.8)	12 (35.3)
3+		2 (15.4)	
4+	10 (66.7)		1 (2.9)
5+	2 (i3.3)		

Table 3.11. Breakdown of electrofishing relative abundance for salmonid species by age class in Evans, 1991.

Age	Cutthroat trout 6/91	Cutthroat trout 8/91	Cutthroat trout 10/91
o+	6 (20.0)	25 (37.9)	35 (32.7)
l+	14 (46.7)	11 (16.7)	17 (15.9)
2+	6 (20.0)	13 (19.7)	31 (29.0)
3+	4 (13.3)	11 (16.7)	18 (16.8)
4+		6 (9.1)	6 (5.6)

Six hundrend and thirty-one fish were captured from Benewah Creek in June, 1991 (Table 3.7). Fifteen (2.4) of the 631 fish were cutthroat trout, 3 (0.5%) were eastern brook trout, 362 (57.4%) were date spp., 23 (3.6%) were longnose sucker, 4(0%.6%) were northern squawfish, 6 (1 .O%) were pumpkinseed, 183 (29.0%) were redside shiner, 34 (5.4%) were sculpin spp. and 1 (0.2%) was yellow perch (Table 3.8). Of the fifteen cutthroat trout captured in Benewah Creek during June, three (20.%) were 2+, ten (66.7%) were 4+, and two (13.3%) were 5+ of age (Table 3.10).

A total of 236 fish were captured in Evans Creek in June (Table 3.7). 30 (12.8%) of the 236 were cutthroat trout and 206 (87.3%) were sculpin *spp* (Table 3.8). Of the thirty cutthroat trout captured in Evans Creek during June, six (20.%) were 0+, 14 (46.7%) were I+, six (20.0%) were 2+, and four (13.3%) were 3+ of age (Table 3.1 I).

A total of 171 fish were collected from Lake Creek (Table 3.7). Three (1.7%) were cutthroat trout, 33 (19.3%) were dace *spp.,* 21 (12.3%) were redside shiners and1 14 (66.7%) were sculpin *spp* (Table 3.8). Of the three cutthroat trout collected during June, two (66.7%) were 2+ and one (33.3%) was 3+ of age (Table 3.12).

Fighting Creek produced a total of 29 fish (Table 3.7). Twenty-seven (93.1%) of the 29 were cutthroat trout and 2 (6.9%) were longnose suckers (Table 3.8). Of the twenty seven cutthroat trout captured in Fighting Creek during June, 22 (81.5%) were 2+ and 5 (18.5%) were 3+ of age (Table 3.13).

Hell's Gulch produced a total of nine fish (Table 3.7). One(11 .1 %) of the nine fish was a cutthroat trout and eight (88.8%) were eastern brook trout (Table 3.8).

A total of 833 fish were captured in the Plummer system (Table 3.7). Four (0.5%) cutthroat trout were captured as well as 5 (0.6%) eastern brook trout, 677 (81.3%) dace spp, 10 (1.2%) longnose suckers,4 (0.5%) northern squawfish,44 (5.3%) redside shiners, and 89 (10.7%) sculpin spp. (Table 3.8) Of the four cutthroat trout collected, three (75%) were 2+ and one (25.0%) was 5+ of age (Table 3.14).

Table 3.12. Breakdown of electrofishing relative abundance for salmonid species by age class in Lake Creek, 1991.

Age	Cutthroat trout 6/91	8/91	10/91
o+		10 (23.8)	9 (16.1)
1+		21 (50.0)	36 (64.3)
2+	2 (66.7)	5 (11.9)	1 (1.80
3+	1 (33.3)	6 (14.3)	10 (17.9)

Table 3.13. Breakdown of electrofishing relative abundance for salmonid species by age class in Fighting Creek, 1991.

Age	Cutthroat trout 6/91	8/91	10/91
o+			
l+			
2+	22 (81.5)		
3+	5 (18.5)		

Table 3.14. Breakdown of electrofishing relative abundance for salmonid species by age class in Plummer Creek, 1991.

Age	Cutthroat trout 6/91	8/91	10/91
o+			
l+			
2+	3 (75.0)		
3+			
4+			
5+	1 (25.0)		

In August, a total of 12.2 hours were spent collecting 1,824 fish from four tributaries. A total of 245 fish were collected from Alder Creek in August (Table 3.15). Nine (3.7%) were cutthroat trout, 97 (39.6%) were eastern brook trout and 139 (56.7%) were sculpin spp. (Table 3.16). Of the nine cutthroat trout collected during August three (33.3%) were 2+ and 6 (66.7%) were 3+. Of the 97 eastern brook trout collected, 20 (20.6%) were 0+, 32 (33.0%) were l+, 35 (36.1%) were 2+, and 10 (10.3%) were 3+ of age (Table 3.9).

A total of 1,108 fish were collected from Benewah Creek in August (Table 3.15). A total of 13 (1.2%) cutthroat trout were collected as well as 698 (62.9%) dace *spp,* 12 (1 .1%) longnose dace, 278 (25.1%) redside shiner, and 107 (9.7%) sculpin *spp.* (Table 3.16). Of the 13 cutthroat trout captured during August, six (46.2%) were 0+, one (7.7%) was l+, four (30.8%) were 2+ and two (15.4%) were 3+ of age (Table 3.10).

Two hundrend twenty six fish were collected from Evans Creek in August (Table 3.15). Sixty-six (29.2%) of the fish were cutthroat trout and 160 (70.8%) were sculpin spp.(Table 3.16). Of the 66 trout collected in Evans Creek during August, 25 (37.9%) were 0+, 11 (16.7%) were l+, 13 (19.7%) were 2+, 11 (16.7%) were 3+ and six (9.1%) were 4+ age (Table 3.11).

A total of 245 fish were collected from Lake Creek during August (Table 3.15). 42 (17.1%) cutthroat trout were collected as well as 90 (36.7%) dace *spp,* 1 (0.4%) longnose sucker, 29 (11.8%) redside shiner, and 83 (33.9%) sculpin *spp.* (Table 3.16). Of the 42 cutthroat trout captured, ten (23.8%) were 0+, 21 (50.0%) were l+, five (11.9%) were 2+ and six (14.3%) were 3+ of age (Table 3.12).

In October a total of 17.2 hours were spent collecting 2,153 fish (Table 3.17) in four tributaries. A total of 408 fish were captured from Aider Creek (Table 3.17). Of the 408 fish, 18 (4.4%) were cutthroat trout, 118 (28.7%) were eastern brook trout, 36 (8.8%) were longnose suckers, and 237 (58.1%) were sculpin spp.(Table 3.18). Of the 18 cutthroat trout collected from Alder Creek, six (33.3%) wee 2+ and 12 (66.7%) were 3+. Of the 118 eastern brook trout captured, ten (8.5%) were 0+, 52 (44.1%) were l+, 37 (31.4%) were 2+, and 19 (16.1%) were 3+ of age (Table 3.9).

Table 3.15. Number of each species of fish caught by electrofishing at each Coeur d'Alene tributary in August, 1991.

Species Shock time (min)	Alder 120.1	Benewah 360.5	Evans 170.4	Lake 79.3
Cutthroat trout	9	13	66	42
Eastern brook trout	97			
Sculpin *spp.*	139	107	160	83
Longnose sucker		12		1
Redside shiner		278		29
Dace *spp.*		698		90
TOTAL	**245**	**1,108**	**226**	**245**

Table 3.16. Percent of each species of fish caught by electrofishing at each Coeur d'Alene tributary in August, 1991.

Species	Alder	Benewah	Evans	Lake
Cutthroat trout	3.7	1.2	29.2	17.1
Eastern brook trout	39.6			
Sculpin *spp.*	56.7	9.7	70.8	33.9
Longnose sucker		1.1		0.4
Redside shiner		25.1		11.8
Dace *spp.*		62.9		36.7

Table 3.17. Number of each species of fish caught by electrofishing at each Coeur d'Alene tributary in October, 1991.

Species Shock time (min)	Alder 284.8	Benewah 361.6	Evans 116.8	Lake 271.4
Cutthroat trout	18	33	107	56
Eastern brook trout	117	6		
Rainbow trout		1		
Sculpin *spp.*	237	72	89	279
Longnose sucker	36	277		2
Redside shiner		258		4
dace *spp.*		480		80
Total	**408**	**1,127**	**197**	**421**

Table 3.18. Percent of each species of fish caught by electrofishing at each Coeur d'Alene tributary in October, 1991.

Species	Alder	Benewah	Evans	Lake
Cutthroat trout	4.4	2.9	54.3	13.3
Eastern brook trout	28.7	0.5		
Rainbow trout		0.09		
Sculpin *spp.*	58.1	6.4	45.2	66.3
Longnose sucker	8.8	24.6		0.5
Redside shiner		22.9		1.0
dace *spp.*		42.6		19.0

A total of 1,127 fish were collected from Benewah Creek in October (Table 3.17). Thirty-three (2.9%) cutthroat trout, 6 (0.5%) eastern brook trout, 1 (0.09%) rainbow trout, 480 (42.6%) dace spp., 277 (24.6%) longnose suckers, 258 (22.9%) redside shiners, 72 (6.4%) sculpin spp. were collected (Table 3.18). Of the 33 cutthroat trout collected in October, five (14.7%) were 0+, 16 (47.1%) were l+, 12 (35.3%) were 2+ and one (2.9%) was 4+ of age (Table 3.10).

Evans Creek produced a sample of 197 fish (Table 3.17). Of the 197 fish, 107 (54.3%) were cutthroat trout and 89 (45.2%) were sculpin *spp.* (Table 3.12). Of the 107 cutthroat trout, 35 (32.7%) were 0+, 17 (15.9%) were l+, 31 (29.0%) wee 2+, 18 (16.8%) were 3+ and 6 (5.6%) were 4+ of age (Table 3.18).

Four hundrend twenty-one fish were collected from Lake Creek in October (Table 3.17). 56 (13.3%) cutthroat trout were collected as well as, 80 (19.0%) dace *spp.,* 2 (0.5%) longnose suckers, 4 (1 .O%) redside shiners and 279 (66.3%) sculpin *spp.* (Table 3.18). Of the 56 cutthroat trout captured, nine (16.1%) were 0+, 36 (64.3%) were l+, one (1.8%) was 2+ and ten (17.9%) was 3+ of age (Table 3.12).

3.2.2. Population estimates

In October, population estimates were conducted in four selected tributaries. Population estimates, 95% confidence intervals and fish densities for each trout species captured in Benewah Creek can be found in Table 3.19. Only cutthroat trout populations could be estimated for Benewah Creek due to low sample size of other trout species. In reach 1, no cutthroat trout were captured. In reach 2 the estimated population of cutthroat trout is 5.0 + 0.0 with a density of 0.7 ± 0.0 per 100 m2. The estimated population of cutthroat trout for reach three was 18.5 ± 2.3 with a density of 3.6 ± 0.4 per 100 m2.

Cutthroat and eastern brook trout populations were estimated for Alder Creek (Table 3.20). In reach 1, cutthroat trout populations were estimated at 5.3 ± 1.9 fish for 231 m^2, with a density of 2.3 ± 0.8 per 100m2. Eastern brook trout populations were estimated at 9.8 ± 3.3 fish for 231 m^2, with a density of 4.2 ± 1.4 per 100 m^2. In Reach two, cutthroat trout populations were estimated at 4.0 ± 0.1 for 285.8 m^2, with a density of 1.4 ± 0.1 for 100 m2. Population estimates for eastern brook trout were 8.3 ± 0.1 for 285.8 m2 with a

Table 3.19 Estimated population, 95% confidence intervals, and fish density for each trout species captured in Benewah Creek at each reach in October, 1991.

SPECIES	EST. POP.	95% C.I.	#/100m^2 ±95% C.I.
Reach # 1 (691.0 m^2)			
Cutthroat trout	0.0		
Reach # 2 (689.6 m^2)			
Cutthroat trout	5.0	± 0.0	0.7 ± 0.0
Reach # 3 (518.5 m^2)			
Cutthroat trout	18.5	± 2.3	3.6 ± 0.4

Table 3.20 Estimated population, 95% confidence intervals, and fish density for each trout species captured in Alder Creek at each reach in October, 1991.

SPECIES	EST. POP.	95% C.I.	#/100m^2 ±95% C.I.
Reach # 1 (231 m^2)			
Cutthroat trout	5.3	± 1.9	2.3 ± 0.8
Eastern brook trout	9.8	± 3.3	4.2 ± 1.4
Reach # 2 (285.8 m^2)			
Cutthroat trout	4.0	± 0.1	1.4± 0.1
Eastern brook trout	8.3	± 8.3	2.9 ± 1.4
Reach # 3 (291.8 m^2)			
Cutthroat trout	4.0	± 0.1	1.4 ± 0.0
Eastern brook trout	57.9	± 5.3	19.8 ± 1.8
Reach # 4 (231.0 m^2)			
Cutthroat trout	2	± 0.0	0.9 ± 0.0
Eastern brook trout	46.3	± 4.8	20.0 ± 2.1

density of 2.9 ± 1.4 per 100 m 2. In reach three estimated cutthroat trout populations were 4.0 ± 0.1 for 292 m2 with a density of 1.4 ± 0.0 per 100 m2. Eastern brook trout populations were estimated at 57.9 ± 5.3 for 292 m2 with a density of 19.8 ± 1.8 for 100 m2. Cutthroat trout populations were estimated at 2 ± 0.0 for 231 m2 with a density of 0.9 ± 0.0 for reach four. Eastern brook trout densities were estimated at 46.3 ± 4.8 for 231 m2 with a density of 20 ± 2.1 per 100 m2.

Cutthroat trout were the only trout population estimated for Lake Creek (Table 3.21). Reach one had an estimated cutthroat population of 32 ± 19.2 for 238 m2 with a density of 13.4 ± 8.1 per 100 m^2. In reach two cutthroat populations were estimated at 23.1 ± 5.4 for 214 m2 with a density of 10.8 ± 2.5 for 100 m2. In reach 3 cutthroat populations were estimated at 12.0 ± 11.8 for 177 m^2, with a density of 6.8 ± 6.7 for 100m^2. In reach 4, cutthroat populations were estimated at 2.0 ± 0.0 for 229 m2 with a density of 0.9 ± 0.0 for 100 m2.

Cutthroat trout populations were estimated for Evans Creek (Table 3.22). In reach 1, cutthroat populations were estimated at 44.3 ± 9.8 for 195 m2 with a density of 22.7 ± 5.0 per 100 m2. In reach 2, cutthroat trout populations were 17.6 ± 4.2 for 195 m2 with a density of 9.0 ± 2.2 for 100 m^2. In reach 3, cutthroat trout populations were estimated at 58.7 ± 6.5 for 244 m2 with a density of 24.1 ± 2.7 for 100 m2.

3.2.3. Age, Growth and Condition

Benewah Creek:

Back calculated lengths for cutthroat trout at the first annulus ranged from 56 to 99 mm with a grand mean of 68 mm (Table 3.23). At the formation of the second annulus lengths ranged from 106 to 136 mm with a mean of 118 mm. At the end of the third years growth mean sizes ranged from 139 to 218 mm with a grand mean of 176. At the end of the fourths years growth sizes ranged from 234 to 260 with a grand mean of 254 mm. The length at the fifth annulus was 289 mm.

Table 3.21 Estimated population, 95% confidence intervals, and fish density for each trout species captured in Lake Creek at each reach in October, 1991.

SPECIES	EST. POP.	95% C.I.	#/100 m^2 ±95% C.I.
Reach # 1 (237.9 m^2)			
Cutthroat trout	32.0	± 19.2	13.4 ± 8.1
Reach # 2 (213.5 m^2)			
Cutthroat trout	23.1	± 5.4	10.8 ± 2.5
Reach # 3 (176.9 m^2)			
Cutthroat trout	12.0	± 11.8	6.8 ± 6.7
Reach # 4 (228.8 m^2)			
Cutthroat trout	2.0	± 0.0	0.9 ± 0.0

Table 3.22. Estimated population, 95% confidence intervals, and fish density for each trout species captured in Evans Creek at each reach in October, 1991.

SPECIES	EST. POP.	95% C.I.	#/100m^2 ±95% C.I.
Reach # 1 (195.2 m^2)			
Cutthroat trout	44.3	± 9.8	22.7 ± 5.0
Reach # 2 (195.2 m^2)			
Cutthroat trout	17.6	± 4.2	9.0 ± 2.2
Reach # 3 (244.0 m^2)			
Cutthroat trout	58.7	± 6.5	24.1 ± 2.7

Table 3.23. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Benewah Creek, 1991.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS				
Cohort	N	1	2	3		
1990	24	56.3±7.7				
1989	21	75.6±11.3	115.3±14.5			
1988	9	66.1±10.1	105.7±20.5	139.2±29.0		
1987	1	98.6	140.1	192.6	213.5	
1986	8	84.9±12.2	135.9±18.3	214.7±20.4	259.6±18.3	289.4±20.5
GRAND MEAN	63	68.4±14.8	117.9±19.5	175.7±44.8	254.4±22.9	289.4±20.5
MEAN ANNUAL GROWTH INCREMENT		68	50	58	79	35

Table 3.24. Mean lengths, weights and condition factors for each age class of cutthroat trout in Benewah Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	3	1.3±0.6	59.3±6.7	0.65±0.26
1+	24	3.7±4.2	71.7±7.2	0.90±0.46
2+	21	28.2±17.8	139.0±16.4	0.98±0.48
3+	9	35.4±10.3	161.3±37.9	0.88±0.10
4+	1	155.0	245.0	1.05
5+	4	255.8±50.9	311.8±22.8	1.0±0.11
Total	62			0.92±0.39

Mean condition factors ranged from 0.65 for 0+ to 1 .O for 5+ cutthroat trout (Table 3.24), with an overall condition factor of 0.92.

Alder Creek

Back-calculated lengths for cutthroat trout at the first annulus ranged from 63 to 73 mm with a grand mean of 67 mm. At the formation of the second annulus lengths ranged from 102 to 104 mm with a grand mean of 103 mm. The length of the third annulus was 142 mm (Table 3.25).

Mean condition factors ranged from 0.83 for l+ to 0.88 for 2+ cutthroat trout, with an overall value of 0.87 (Table 3.26).

Back-calculated lengths for eastern brook trout at the first annulus ranged from 77mm to 95 mm with a grand mean of 79 mm. At the end of the second years growth lengths ranged from 120 mm to 157 mm with a grand mean of 132. The length at the third annulus was 182 mm.

Mean condition factors ranged from 0.8 for 0+ and 3+ to 0.9 for l+ and 3+ with an overall condition factor of 0.9.

Lake Creek

Back-calculated lengths for cutthroat trout at the first annulus ranged from 56 to 70 mm with a grand mean of 60 mm. At the end of the second years growth lengths ranged from 97 to 110 mm with a grand mean 107 mm. Length of the third annulus was 135 mm (Table 3.29).

Mean condition factors ranged from 0.82 for 2+ cutthroat trout to 1.05 for 0+, with an overall mean of 0.88 (Table 3.30).

Evans Creek

Back-calculated lengths for cutthroat trout at the first annulus ranged from 66 to 74 mm with a grand mean of 67 mm. at the end of the second years growth sizes ranged from 99 to 114 mm with a grand mean of 101 mm. Lengths at the third annulus ranged

Table 3.25. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Alder Creek, 1991.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS		
Cohort	N	1	2	3
1990	6	72.6 ± 4.1		
1989	10	63.4 ± 5.6	104.5 ± 15.4	
1988	10	67.3 ± 8.3	102.1 ± 11.3	142.4 ± 34.20
GRAND MEAN	26	67.0 ± 7.2	103.3 ± 13.2	142.4 ± 34.2
MEAN ANNUAL GROWTH INCREMENT		67	36	39

Table 3.26. Mean lengths, weights and condition factors for each age class of cutthroat trout in Alder Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
1+	4	123.7 ± 6.9	16.5 ± 3.1	0.83 ± 0.16
2+	10	159.7 ± 33.0	42.7 ± 38.3	0.88 ± 0.12
3+	14	220.6 ± 49.7	87.8 ± 54.3	0.87 ± 0.28
Total	28			0.87 ± 0.21

Table 3.27. Mean back-calculated lengths of each year's growth (annulus formation) for each age class of eastern brook trout in Alder Creek, 1991.

Cohort	N			
1990	55	76.6±8.6		
1989	36	73.7±11.9	120.3±18.8	
1988	17	95.2±6 1.2	156.8f68.4	181.5±44.2
Grand mean		78.7k26.4	132.1k44.4	181.5±44.2
Mean annual growth increment		79	53	50

Table 3.28. Mean lengths, weights, and condition factors for each age class of eastern brook trout in Alder Creek.

Age	N	Mean Weight (±SD)	Mean Length (±SD)	Mean K_{tl} (±SD)
0+	50	14.3±11.2	111.5±23.6	0.8±0.5
1+	55	21.1±28.3	113.9±43.6	0.9±0.1
2+	36	23.5±7.1	139.8±12.9	0.8±0.1
3+	18	89.6±42.0	211.4±26.9	0.9±0.2
TOTAL	159			0.9±0.4

Table 3.29. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Lake Creek, 1991.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS		
Cohort	N	1	2	3
1990	61	56.2±7.1		
1989	18	70.0±11.3	110.0±25.5	
1988		66.0±4.9	97.3±9.9	135.4±6.8
GRAND MEAN		59.8±9.9	106.8±23.1	135.4±6.8
MEAN ANNUAL GROWTH INCREMENT		60	48	26

Table 3.30. Mean lengths, weights and condition factors for each age class of cutthroat trout in Lake Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	13	2.1±1.0	58.2±4.7	1.05f0.5
1+	58	3.91t1.8	76.4±10.1	0.85±0.3
2+	18	21.2±15.1	130.8±26.2	0.82±0.19
3+	6	36.5f8.3	160.7±4.5	0.88±0.19
Total	95			0.88±0.32

from 138 to 145 mm with a grand mean of 138 mm. Length at the fourth annulus was 185 mm (Table 3.31).

Mean condition factors ranged from 0.84 for 0+ to 1.22 for 4+ cutthroat trout. An overall condition factor of 0.88 was calculated for Evans Creek cutthroat (Table 3.32).

Fighting Creek

Back-calculations were made using the proportional method since a good regression could not be obtained for the body length-scale relationship. Back-calculated lengths at the end of the first years growth ranged from 49 to 55 mm with a grand mean of 53 mm. At the end of the second years growth lengths ranged from 93 to 97 mm with a grand mean of 97 mm. At the third annulus the length was 140 mm (Table 3.33).

Condition factors ranged from 0.9 for 2+ cutthroat trout to 1.07 for 3+ with an overall mean of 0.92 (Table 3.34).

Plummer Creek

Back-calculations were made using the proportional method since a good regression could not be obtained for the body length-scale relationship. Back-calculated lengths at the end of the first years growth ranged from 44 to 76 mm with a grand mean of 70 mm. At the end of the second years growth lengths ranged from 69 to 140 mm with a grand mean of 126 mm. At the end of the third years growth sizes ranged from 137 to 184 mm with a grand mean of 175 mm. Size at the fourth and fifth annulus was 211 and 253 mm, respectively (Table 3.35).

A condition factor of 1.01 was obtained for 3+ cutthroat trout in Plummer Creek (Table 3.36).

3.2.4. Creel Survey

Creel surveys were conducted monthly from May through August. Due to the low numbers or lack of anglers contacted not enough data was gathered to accurately calculate harvest or angler pressure estimates. Also, because of the lack of water present in the streams during summer, creel surveys were eliminated for the following year. The only month in which any fishing pressure existed was during May, coinciding with peek spawning runs of

Table 3.31. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Evans Creek, 1991.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS			
Cohort	N	1	2	3	4
1990	67	65.9±12.6			
1989	39	67.4±10.3	99.1±13.5		
1988	17	66.5±9.4	104.8±12.6	138.0±22.7	
1987	1	73.8	114.4	144.8	185.4
GRAND MEAN		66.5±11.4	101.1±13.4	138.4±22.1	185.4
MEAN ANNUAL GROWTH INCREMENT		67	34	37	47

Table 3.32. Mean lengths, weights and condition factors for each age class of cutthroat trout in Evans Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	40	1.5±0.7	56.0±5.9	0.84±0.24
1+	63	8.5±5.7	95.2±23.4	0.88±0.37
2+	33	18.8±11.0	125.1±22.2	0.87±0.12
3+	13	46.2±30.4	160.8±26.2	0.94±0.12
4+	1	141	226	1.22
Total	150			0.88±0.28

Table 3.33. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Fighting Creek, 1991.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS		
Cohort	**N**	**1**	**2**	**3**
1990				
1989		54.6±7.2	97.1±8.8	
1988		44.8±9.1	93.1±20.3	140.4±13.1
GRAND MEAN		53.0±8.0	96.6±10.3	140.4±13.1
MEAN ANNUAL GROWTH INCREMENT		53	44	44

Table 3.34. Mean lengths, weights and condition factors for each age class of cutthroat trout in Fighting Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
2+	20	13.5k5.1	113.1±9.9	0.9±0.16
3+	3	44.7±2 1.4	158.3±14.3	1.07±0.23
Total	23			0.92±0.18

Table 3.35. Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Plummer Creek, 1991.

Cohort	N	MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS				
		1	2	3	4	5
1989	1	44.1	69.4			
1988	4	75.7±13.9	140.4±32.8	184.3±55.7		
1986	1	73.8	115.9	137.0	210.8	252.9
GRAND MEAN		70.1±16.7	124.5±38.3	174.8±52.6	210.8	252.9
MEAN ANNUAL GROWTH INCREMENT		70	54	50	35	42

Table 3.36. Mean lengths, weights and condition factors for each age class of cutthroat trout in Plummer Creek, 1991.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
3+	3	34.3±1.2	150.7±5.5	1.01±0.12
Total	3			1.01±0.12

cutthroat trout. Fishing pressure existed only in those streams in which known runs of cutthroat trout existed, those being Benewah and Lake creeks

3.3. MACROINVERTEBRATE STUDIES

3.3.1. Benthic samples

A total of 75 hess samples were collected from tributaries during 1991. Mean densities of benthic macroinvertebrates in Hess samples ranged from a low of 1205.3 organisms/m2 in Alder Creek to a high of 2885.6 organisms/m 2 in Evans Creek. (Table 3.37). The density for Benewah Creek was 2,296.5 organisms/m2 and 1708.3 organisms/m2 in Lake Creek.

Chironomidae larvae was the most abundant macroinvertebrate in Alder, Benewah, Evans and Lake creeks at 32.21%, 40.2%, 22.83% and 37.50%, respectively. The second most abundant macroinvertebrate in Alder and Lake creeks were Elmidae larvae at 13.0% and 12.%% respectively (Table 3.39). The second most abundant macroinvertebrate in Benewah Creek was Leptophlebiidae at 10.3% and Baetidae at 11.7% in Evans Creek. Mean densities of benthic macroinvertebrates collected in hess samples by sample site and month can be found in Appendix C.

3.3.2. Drift samples

Fifty one drift samples were collected from the tributaries during 1991. Mean densities of invertebrates ranged from a low of 192.4 organisms/100m3 in Lake Creek to 265.7 organism/m3 in Evans Creek (Table 3.38). densities for Benewah and Alder creeks were 204.4 and 2.01.3 organisms/m3, respectively.

Chironomidae pupae were the most abundant macroinvertebrate collected in the drift on Benewah Creek at 18.6% followed by Chironomidae larvae and Helicopsychidae at 13.5% and 13.4%, respectively (Table 3.40). Baetidae was the most abundant organism found in Alder Creek at 33.6% followed by Ephemerellidae at 15.0% and Chrionomidae pupae at 11.7%. Elmidae larvae were the most abundant macroinvertebrate collected in drift samples from Lake Creek at 22.1% followed by Baetidae and Chironomidae larvae at 8.4% and 6.3%, respectively. Ephemerellidae was the most abundant organisms collected in Evans Creek at 27.6% followed by

Table 3.37. Mean densities of macroinvertebrates (#/m3) collected in Hess samples from selected tributaries during 1991. Sample sizes enclosed in parentheses.

	Benewah	Alder	Evans	Lake
June	2030 (6)	1206.7 (6)	2106.7 (6)	2695.0 (3)
August	2842.8 (9)	929.4 (6)	2640.0 (6)	1420.0 (6)
October	2686.7 (9)	1480.0 (6)	3911.7 (6)	1010.0 (6)
Annual X	2535.0 (24)	1205.4 (18)	2885.6 (18)	1708.3(15)

Table 3.38. Mean densities of macroinvertebrates (#/1 00 m3) collected in drift samples from selected tributaries during 1991. Sample sizes enclosed in parentheses.

	Benewah	Alder	Evans	Lake
June	87.7 (3)	81.9 (4)	49.4 (4)	307.5 (2)
August	53.1 (6)	234.8 (4)	255.1 (4)	225.6 (4)
October	472.3 (6)	286.2 (4)	492.5 (6)	44.1 (4)
Annual X	204.4 (15)	201.3 (12)	265.7 (14)	192.4 (10)

Table 3.39 Mean annual number of benthic macroinvertebrates per square meter (collected by hess sampler) in selected tributaries of the Coeur d'Alene Indian Reservatlon for the 1991 sampling period.

	ALDER		BENEWAH		EVANS		LAKE	
	annual x	% abund	annual x	% abund	annual x	% abund	annual x	% abund
QUATICS								
TRICHOPTERA								
Glossosomatidae	2.76	0.23	6.42	0.33	279.44	9.66	6.67	0.39
Brachycentridae	84.28	6.99			23.33	0.61	1.67	0.13
Hydropsychidae	8.94	0.74	75.26	2.97	113.33	3.93	1.67	0.10
Hydroptilidae	20.56	1.71	11.39	0.45	6.67	0.23	0.00	0.00
Helicopsychidae	0.10	<0.01	17.50	0.69				
Limnephilidae	15.56	1.29	63.98	2.52	3.33	0.12	1.11	0.09
Rhyacophilidae	0.67	0.06	0.56	0.02	28.89	1.00	0.00	0.00
Phryganeidae							0.56	0.03
T. pupae			1.11	0.04				
EPHEMEROPTERA								
Tricorythidae			8.61	0.34				
Heptageniidae	53.22	4.42	176.11	6.95	300.56	10.42	133.89	7.84
Ephemerellidae	98.78	8.20	163.43	6.45	116.11	4.02	97.78	65.72
Baetidae	55.11	4.57	248.80	9.81	337.76	11.71	61.11	4.75
Leptophleblldae	21.39	1.78	261.02	10.30	37.76	1.31	43.89	2.57
PLECOPTERA								
Chloroperlidae	20.63	1.73	15.65	0.62	317.22	10.99	126.11	7.30
Perlidae	9.63	0.62	13.05	0.51	16.33	0.64	11.11	0.65
Perlodidae	37.61	3.12	53.15	2.10	120.56	4.18	177.22	10.37
Peltoperlidae					24.44	0.85		
Nemouridae	14.44	1.20	2.31	0.09	97.78	3.39	116.67	0.96
Capniidae					2.22	0.08	0.56	0.03
COLEOPTERA								
Elmidae larvae	157.00	13.03	60.63	2.40	118.89	4.12	196.11	i1.48
Elmidae adults	13.22	1.10	19.06	0.75	6.67	0.23	9.44	0.55
Dytiscidae	2.50	0.21	0.74	0.03	0.56	0.02	2.22	0.13
Hydrophilidae			37.76	1.49				
Psephenidae			13.33	0.53				
DIPTERA								
Chironomidae larvae	366.26	32.21	1020.00	40.24	658.89	22.63	638.69	37.50
Chironomidae pupae	20.72	1.72	16.56	0.65	19.44	0.67	0.56	0.03
Ceratopogonldae	0.06	0.01	1.46	0.06	7.78	0.27	0.56	0.03
Tipulidae	36.69	3.23	70.09	2.77	32.22	1.12	32.76	1.92
Tipulidae pupae			1.67	0.07	0.56	0.02		
Simuliidae	3.39	0.26	5.56	0.22	0.56	0.02	0.00	0.00
Simuliidae pupae					15.00	0.52	11.67	0.66
Tabanidae					0.56	0.02	0.00	0.00
Empididae			5.19	0.20	0.00	0.00	0.00	0.00
Psychodidae	11.33	0.94	3.05	0.12	41.67	1.44	4.44	0.26
Rhagionidae					0.56	0.02		
Anthericidae	2.22	0.16	0.00	0.00				
Dixidae	0.00	0.00	0.37	0.01	0.00	0.00	0.00	0.00
LEPIDOPTERA								
Noctuidae			0.37	0.01				
HYDRACARINA	26.44	2.36	70.00	2.76	44.44	1.54	42.22	2.47
AMPHIPODA								
Taltiridae			6.30	0.25				0.06
CLADOCERA								
Chydoridae			30.00	1.18				
OSTRACODA					5.56	0.19		
OLIGOCHAETA								
Lumbriculidae	19.56	1.62	13.70	0.54	42.78	1.48	0.56	0.03
Naididae	1.67	0.14	1.11	0.04	2.22	0.		0.39

Table 3.39. (cont.)

	ALDER		BENEWAH		EVANS		LAKE	
	annual x	% abund	annual x	% abund	annual x	% abund	annual x	% abund
	22.70	1.89						
NEMATODA	4.56	0.38	12.50	0.49	5.00	0.17	3.89	0.23
MOLLUSCA								
Planorbidae	0.56	0.05	1.11	0.04				
Physidae			0.74	0.03			5.00	0.29
Lymanaktae			0.26	0.01			1.11	0.07
BIVALVIA								
Unbnktae	1.11	0.09						
Sphaeriidae	20.72	1.72	6.65	0.27	10.56	0.37	0.56	0.03
ERRESTRIALS								
DIPTERA								
Chlronomldae			1.11	0.04				
Drosophilldae	0.06	0.01					0.56	0.04
EPHEMEROPTERA								
Baetidae	0.06	0.01						
COLEOPTERA								
Lathridiidae	0.56	0.05						
Curculionidae	0.22	0.02	0.37	0.01	0.56	0.02	1.11	0.04
Carabidae			1.67	0.07				
HEMIPTERA								
Gerridae							2.22	0.07
Corixidae							2.78	0.16
Beloatomatldae					0.56	0.02		
HOMPOTERA								
Aphididae	0.89	0.07					1.67	0.16
Cicadellidae	0.89	0.07						
HYMENOPTERA								
Bethyloidae					0.56	0.02		
Formicidae	0.22	0.02			2.22	0.08		
THYSANOPTERA								
Thrlpldae	1.22	0.10						
TRICHOPTERA								
Unk trich aduil	5.56	0.46			2.78	0.10	40.0	2.34
Limnephilidae			0.37	0.01				
ARANEIDA			0.74	0.03	1.67	0.06		
ARACHNID	0.56	0.05	0.74	0.03	1.67	0.06	0.56	0.03
ODONATA								
Aeshnidae			0.56	0.02				
Petaluridae			2.22	0.09				
Coenagrionidae			1.67	0.07				
DECAPODA								
Astacidae	1.11	0.09					2.22	0.13
Gastropoda	0.56	0.05						
Colembob					0.56	0.02		
OSTEICHTHYES	1.17	0.10	0.74	0.03	2.78	0.10		
UNKNOWN	11.11	0.92	5.74	0.23	30.56	1.06	0.56	0.03
TOTAL	1205.33	100.00	2534.99	100.00	2885.56		1706.3	100.00

Table 3.40. Mean annual number of benthic macroinvertebrates per square meter **(collected by drift sampler)** in selected tributaries of the Coeur **d'Alene Indian Reservation for the** 1991 sampling period.

	Benewah		Aider		Lake		Evans	
	annual mean	% abund	annual mean	% abund	annual mean	% abund	annual mean	% abund
QUATICS								
TRICHOPTERA								
Glossosomatidae	0.7	0.3	1.3	0.5	1.2	0.6	4.7	1.8
Brachycentridae	3.0	1.4	3.9	1.9	0.6	0.3	1.7	0.6
Hydropsychidae	2.7	1.3	0.7	0.4			4.6	1.7
Hydroptllldae	1.7	0.8						
Limnephilidae	1.3	0.6	0.4	0.2	0.5	0.3	1.0	3.6
Rhyacophilidae	0.7	0.3	0.2	0.8	0.7	0.4	4.3	1.6
Leptoceridee					0.2	0.1		
Phryganeidae					0.2	0.1		
Lepidostomatidae					0.2	0.1		
Helicopsychidae	27.7	13.4						
EPHEMEROPTERA							3.4	11.4
Heptagenlidae	6.8	3.3	6.6	3.3	2.6	1.3	9.9	3.7
Ephemerellidae	6.0	3.4	3.1	15.0	1.8	5.3	73.4	27.6
Baetidae	11.2	5.4	67.7	33.6	16.9	8.4	2.2	0.8
Leptophlebiidae	9.4	4.5	3.9	1.0	9.7	5.7		
PLECOPTERA					1.2	0.6	14.8	5.6
Chloroperlidae	0.7	0.4	1.5	0.7	1.5	0.5	0.4	0.2
Perlidae			0.3	0.2	1.5	0.5	1.1	0.4
Perlodidae	0.6	0.3	1.6	0.8	0.6	0.3		
Peltoperlidae					0.6	0.3	7.3	2.8
Capniidae					0.2	0.1		
Nemouridae	0.8	0.4			0.2	0.1		
Leuctridae					1.2	0.7		
Capniidae					1.2	0.6		
COLEOPTERA			0.8	0.4	38.8	2.2		
Elmidae larvae	0.6	0.3	12.6	6.0	42.4	22.1	2.5	0.9
Elmidae adults	0.1	0.5	0.8	0.4	4.3	2.2	0.4	0.2
Dytiscidae					0.6	0.3		
Hydrophilidae	3.3	1.6			0.2	0.1		
Amphizoidae					0.2	0.1	0.2	0.6
Chrysomelidae					0.5	0.3		
Corcinellidae					0.5	0.3		
DIPTERA			0.4	0.2	0.0	5.2		
Chironomidae larvae	28.8	13.5	23.6	11.7	12.1	6.3		
Chlmnomldee pupae	38.6	18.6	2.9	1.5	2.3	1.2	5.4	19.0
Ceratopogonidae					1.1	0.6	19.2	7.2
Tipulidae	4.8	2.2 2	6.8	3.4			0.3	0.1
Tipulidae pupae					3.3	1.7	2.5	0.0
Simuliidae	0.9	0.5	6.8	3.4	2.5	1.3		
Simuliidae pupae					0.2	0.8	0.6	0.2
Psychodidae	1.8	0.0	2.4	1.2			1.9	0.4
Dixidae					0.5	0.3		
Blephariceridae	0.3	0.1	0.2	0.1	0.6	0.3	0.4	0.2
Blephariceridae					0.5	0.3		
Chaoboridae larvae					0.7	0.4		
Chaoboridae pupae					0.2	0.1		
LEPIDOPTERA					0.2	0.1		
Pyralidae					2.7	1.8	0.2	0.6
HYDRACARINA	0.8	0.5	5.8	2.9	[illegible]	[illegible]	9.5	3.6
CLADOCERA								
Chydoridae					0.7	0.4		

Table 3.40. (cont.)

	Benewah annual mean	Benewah % abund	Alder annual mean	Alder % abund	Lake annual mean	Lake % abund	Evans annual mean	Evans % abund
Cyclopoids	2.2	1.4	0.3	0.2	0.7	0.4		
OLIGOCHAETA	0.9	0.4					0.1	0.4
Lumbriculidae			0.6	0.4			1.2	0.4
Naididae			6.8	3.4				
MOLLUSCA								
Planorbidae	0.7	0.3	0.6	0.4				
Lunaeidae	0.2	0.7						
BIVALVIA								
Sphaeridae	0.7	0.3	1.0	0.9				
ERRESTRIALS								
DIPTERA			1.4	0.7	0.3	0.2		
Chironomidae	3.6	1.0			0.3	0.2	6.5	2.4
Ceratopogonidae	0.3	0.1						
Simuliidae	0.4	0.2						
Mycetophilidae					0.3 0.3 0.1	0.2 0.2 0.6		
Drosophilidae								
Sciaridae	5.5	2.6			0.4 0.3	0.2 0.2	0.7	0.3
Dolichopodidae	0.9	0.4						
Bibionidae	1.3	0.6						
Trixoscelidae	2.7	1.3						
EPHEMEROPTERA								
Baetidae	0.0	0.4						
Duns					0.7	0.4		
Amphizoidae					1.4	0.5		
COLEOPTERA					0.4	0.2		
Lathridiidae					0.6	0.3		
Hydrophilidae	0.3	0.1						
Curculionidae	0.3	0.1			0.6	0.3	0.2	0.8
Carabidae	0.3	0.1						
Buprestidae	1.2	0.6						
HEMIPTERA			0.3	0.2				
Reduviidae			0.8	0.4				
Corixidae	0.2	0.7	0.3	0.1			1.7	0.4
Veliidae	0.3	0.2						
Gerridae	0.8	0.3	0.3	0.2				
Hydrophilidae			0.8	0.4				
HOMPOTERA					2.4	1.3		
Lepidosaphes							0.8	0.3
Aphididae	14.2	6.9	3.5	1.7	2.4	1.3	2.6	1.4
Cicadellidae	0.2	0.7	1.1	0.5				
HYMENOPTERA					1.3	0.7		
Apidae								
Formicidae	0.2 1.6	0.8 0.7	2.4	1.2	0.5 1.8	0.9 0.2	0.3	0.1
Maseridae								
Spheidae			0.1	0.7				
Mymaridae	0.9	0.4						
Dupridae	0.1	0.6						
Platygasteridae	0.2	0.8						
THYSANOPTERA								
Thripidae	0.1	0.7	0.3	0.2	0.2 0.2	0.8 0.8	0.3	0.1
TRICHOPTER								
Unk trich adult	0.7	0.3					0.6	0.2
UNKNOWN	0.8	4.7			0.2	0.1	0.9	0.3
ARACHNID	1.9	0.9	1.1	0.5	0.3	0.1	0.4	0.1
OSTEICHTHYES	0.5	0.2	0.9	0.5	0.4	0.2	0.8	0.3
Cottidae					0.5	0.2	0.2	0.8
Coenagridae	0.3	0.1						
Collembola	0.9	0.4			1.4	0.8	0.2	0.7
Aeshnidae	3.7	1.8						
Pentatomidae							0.5	0.2
	27.4	1.0	21.3	1.o	191.a	1.0	265.7	100.0

Chironomidae pupae at 19.0% and Heptageniidae at 11.4%. Mean densities of benthic macroinvertebrates collected in drift samples by sample site and month can be found in Appendix C.

Shannon-Weiner diversity for benthic macroinvertebrates was highest in Alder Creek with a value of 3.85 (Table 3.41). The next highest value was 3.72 for Evans Creek. Hell's Gulch had the lowest diversity index at 2.74.

Diversity values calculated for the drift ranged from 4.14 for Benewah Creek (Table 3.42) to 1.27 for Fighting Creek.

Table 3.41. Shannon-Weiner diversity indices for benthic macroinvertebrates **collected in each tributary.**

	Benewah	Lake	Alder	Evans	Plummer	Fighting	Hells'Gulch
# of Taxa	52	38	44	42	33	28	18
# of indiv.	6553	1084	2380	5082	2015	619	434
Shannon-div.	3.26	3.35	3.85	3.72	3.25	3.07	2.74

Table 3.42. Shannon-Weiner diversity indices for organisms collected in the drift **for each tributary.**

	Benewah	Lake	Alder	Evans	Plummer	Fighting	Hells'Gulch
# of Taxa	61	43	38	39	42	45	18
# of indiv.	959	699	830	1963	807	3465	195
Shannon-div.	**4.14**	3.53	3.67	3.40	3.06	**1.27**	2.63

4.0. DISCUSSION

Land use practices within each selected watershed has contributed to the degradation of the fishery resources on the Coeur d'Alene Indian Reservation. Major habitat problems associated with the area include high sediment input from non-point sources, including agricultural (grazing and farming) and, silvacultural practices. Some stream systems are located in low elevation drainages in which snow melt run-off and rain events are the primary sources of water. These drainages, due to flow constraints (zero flow in summer) and adverse land use practices within the basins, have limited resident fish production potential. However, some drainages offer more extensive and renewable water sources, in which land-use practices can be controlled or modified to enhance the habitat quality and quantity for cutthroat trout. A combination of hatchery production and natural habitat enhancement should be utilized to restore these populations. A limited number of bull trout were collected on reservation waters, suggesting that enhancement efforts should be principally directed towards the restoration of current resident species populations (i.e., cutthroat trout). However, since bull trout populations appear to be in precipitous decline, efforts should also be made to enhance bull trout via hatchery production.

Relative abundance and population data showed that cutthroat trout densities, compared to other Idaho streams, are low for all surveyed tributaries except for Evans Creek. Densities in Evans Creek were comparable to other similar tributaries within the state of Idaho (Table 4.1). For those tributaries which contained brook trout, densities were also comparable to other similar tributaries within the area (Table 4.2).

Cutthroat trout growth rates were low compared to other Idaho streams except those growth rates of fish in Benewah Creek (Table 4.3). Benthic densities were high compared to other Idaho streams suggesting that food production is not a fish population limiting factor (Table 4.4). Specific problems, with a detailed discussion on each individual creek follows

Table 4.1 Comparison of cutthroat trout densities ($\#/100m^2$).

Location	Density	Reference
Coeur d'Alene River Tributaries.		
Brown Creek, ID.	9.3	Apperson et al., (1988)
Copper Creek, ID.	1.6	Apperson et al., (1988)
Cougar Gulch, ID	18.3	Apperson et al., (1988)
Evans Creek, ID (1984)		
Site 1	27.5	Apperson et *al.,* (1988)
st. Joe Tributaries.		
Benewah Creek (1984)		
Site 1	1.4	Apperson et al., (1988)
Site 2	3.2	
Site 3	1.7	
Bond Creek		
Site 1	1.6	Apperson et *al.*, (1988)
Site 2	4.0	
Trout Creek		
Site 1	14.5	Apperson et *al.*, (1988)
Site 2	58.6	
St. Maries River Tributaries		
Alder Creek (1984)		
Site 1	3.8	Apperson et al., (1988)
Site 2	14.2	
Merry Creek		
Site 1	7.6	Apperson et *al.,* (1988)
Site 2	26.0	
Tributaries in current study		
Benewah Creek, ID		
Site 1	0.0	Present study
Site 2	0.7	Present study
Site 3	3.6	Present study
Alder Creek, ID		
Site 1	2.3	Present study
Site 2	1.4	Present study
Site 3	1.4	Present study
Site 4	0.9	Present study
Lake Creek, ID		
Site 1	13.4	Present study
Site 2	10.8	Present study
Site 3	6.8	Present study
Site 4	0.9	Present study
Evans Creek, ID		
Site 1	22.7	Present study
Site 2	9.0	Present study
Site 3	24.1	Present study

Table 4.2 Comparison of eastern brook trout densities ($\#/100m^2$).

Location	Density	Reference
Copper Creek		
Site 1	2.6	Apperson et *al.,* (1988)
Site 2	4.6	
Aider Creek (1984)		
Site 1	0.0	Apperson et *al.,* (1988)
Site 2	3.6	
Fortier Creek	4.2	Apperson et *al.,* (1988)
Benewah Creek (1984)	1.4	Apperson et *al.,* (1988)
Reeds Gulch	132.5	Apperson et *al.*, (1988)
Homor Creek, ID	31.3	Corsi & Elle (1989)
Leiberg Creek, ID	0.1	Gamblin (1987)
Alder Creek		
Site 1	4.2	Present study
Site 2	2.9	Present study
Site 3	19.8	Present study
Site 4	20.0	Present study

Table 4.3. Comparison of mean back-calculated lengths at annulus formation for cutthroat trout.

	(Length at annulus formation)					
	1	2	3	4	5	6
Tributaries to Priest Lake (Carlander, 1969)	86	127	170	201	254	-
N.Idaho Tributaries (Carlander, 1969)						
Upper	53	102	152	224		
Lower	71	135	226	292		
Adfluvial	71	140	216			
East River, Priest River drainage, N. Idaho (Horner 1987)	95	136	171			
Big Creek, Priest River drainage, N. Idaho (Horner 1987)	81	121	154	177		
Skookum Creek, WA (Barber et *al.* 1989)	101	136				
Cee Cee Ah Creek, WA (Barber et *al.* 1989)	94	134				
Tacoma Creek, WA (Barber et *al.* 1989)	101	140	182			
LeClerc Creek, WA (Barber et *al.* 1989)	93	137	178			
Benewah Creek, N. Idaho (Present study)	68	118	176	252	289	-
Alder Creek, N. Idaho (Present study)	67	103	142			
Lake Creek, N. Idaho (Present study)	60	107	135			
Evans Creek, N. Idaho (Present study)	67	101	138	185		
Fighting Creek, N. Idaho (Present study)	53	97	140			
Plummer Creek, N. Idaho (Present study)	70	124	175	211	253	-

Table 4.4. Comparison of benthic macroinvertebrate densities and diversity indices from Coeur d'Alene tributaries with other streams of similar stream order.

Location	Stream order	Density #/m^2	Diversity	Sampling device	Reference
Firehole River,WY		940		Hess	(Armitage, 1958)
Chamokane Creek, WA.	3	53,569	3.27	Hess	(O'Laughlin et *al.* 1988)
Mink Creek, ID. (1968)	3	6,900		Hess	(Minshall, 1988)
Mink Creek, ID (1969)	3	21,000	3.7	Hess	(Minshall, 1981)
Gold Creek, ID.	3	549		Surber	(Oien, 1957)
N. Fork Coeur d'Alene River, ID		4359.5	2.9	Surber	(Savage, 1970)
Crystal Creek, ID	3	602.5		Surber	(Oien, 1957)
Silver Creek, ID	3	688.7		Surber	(Oien, 1957)
Benewah Creek, ID		2535	3.26	Hess	(Present study)
Alder Creek, ID		1205	3.85	Hess	(Present study)
Evans Creek, ID		2885.6	3.72	Hess	(Present study)
Lake Creek, ID		1708.3	3.35	Hess	(Present study)
Plummer		*	3.06	Hess	(Present study)
Fighting		*	3.07	Hess	(Present study)
Hell's Gulch		*	2.74	Hess	(Present study)

4.1. TARGET TRIBUTARIES

Target tributaries were chosen based on their relative high quality fisheries habitat and potential habitat enhancement opportunities. These tributaries included Lake, Benewah, Evans and Alder creeks.

4.1.2. Lake Creek

The major potential limiting factor restricting the fisheries resources in Lake Creek is the excessive Amount of fine sediment accumulated in the spawning substrate. Inadequate rearing habitat also potentially limits cutthroat trout production. No information was available to determine if over-wintering habitat was a limiting factor (Table 4.5).

Elevated substrate embeddeness directly affects spawning and rearing success. Spawning substrate covered with fine silt creates insufficient interstitial space necessary for gas exchange. This condition reduces egg to alevin survival (Bjornn 1969). Pools also have become filled by fine sediment. This, in turn, has reduced pool depths and smothered invertebrate populations thus contributing to reduced rearing success. Inadequate riparian overhanging vegetation further exacerbates this habitat condition. In a study conducted by the Kootenai-Shoshone Soil Conservation District in 1991, suspended sediment loads as high as 50 tons and turbidity levels as high as 140 NTU's during peak spring runoff were recorded. Without a reduction in sediment, recruitment below optimal habitat conditions will remain.

Cutthroat trout densities in Lake Creek suggest that a depressed but viable population of cutthroat trout exists. Relative abundance estimates indicated that 0+ through 3+ fish were common in Lake Creek suggesting some success in spawning and emergence. The percent of success could not be determined since no data was collected on spawners. This will be addressed in next years work. Population estimates ranged from 0.9 fish/l 00 m^2 to 13.4 fish/l00 m^2. This indicated that Lake creek is potentially underseeded (Bjorn 1978).

Table 4.5. Factors that are potentially limiting trout production (based on ground **surveys and biological** data collection) in selected Coeur d'Alene **tributaries, ID.**

Stream name	Spawning habitat Qual.	Spawning habitat Quant.	Rearing habitat Qual.	Rearing habitat Quant.	over-wint. habitat Qual.	over-wint. habitat Quant.	Sediments	H20 quantity	Temp.	Comments
Fighting/B&grove	*	*	*	*	*	*		*	*	Low base flow and high temp.
Squaw	*	*	*	*	t	*		*	*	Interm. cond.
Hell's Gulch	*	*	*	•	⊠	⊠		⊠	⊠	Interm. cond.
Plummer/L. Plummer	*	*	*	*	•	⊠		•	⊠	Low base flow and high temp.
Lake Creek	•		*		◊	◊				high % embedd exists.
Evans					0	0				
Alder					0	0				Falls may create a high water barrier
Benewah					0	0				

• determined to be a potential limiting factor.
could be a potential limiting factor.
0 not enough information to determine if a potential limiting factor.

Growth rates of cutthroat trout were low compared to other Idaho trout streams. This may be due to excessive sediment input which causes high turbidity levels. Negative effects of growth on trout have been recorded at an exposure of 25 NTU for several days. (Carlander, 1969). It has been documented that levels of 25 NTU's or more affect the trouts ability to visually recognize and capture food prey items. NTU levels of 50 can also cause displacement of salmonids who avoid such turbid waters to rear and feed.

Food availability in Lake Creek was lower than in other study sites, however in general these densities were higher than in other Idaho streams. As demonstrated in section 3.2, embeddeness rates were most elevated in Lake Creek, which potentially reduces invertebrate colonization.

4.1.3. Benewah Creek

Benewah Creek was also picked as a target tributary. Potential limiting factors associated with the Benewah Creek drainage range from quantity and quality of spawning habitat, quality of rearing habitat associated with low flows and high water temperatures during summer. No data on over-wintering habitat is available and will be collected next year Table 4.5).

Factors affecting spawning habitat include sediment input from non-point sources, including silvacultural and livestock grazing practices. Low flows in early summer limit the amount of "washing" the gravels receive, therefore, redds become filled with fine particles. This has the potential to lower emergence success. Bank sloughing is a common occurrence in the middle and upper reaches of Benewah. Little riparian vegetation remains to stabilize and protect the banks.

Rearing habitat is limited to scour holes and beaver ponds in the upper reaches where heavy livestock grazing occurs. Pools are filled with siltly materials and contain very little instream and overhang cover. Temperatures in these pools are in excess of 20°C in summer. These pools are utilized more by red-side shiners and dace *spp.* found in the system.

Cutthroat trout densities were low in Benewah Creek. Most fish captured were between O-3+ years. This suggests that a limited amount of emergence does take place in Benewah yearly. The percent survival could not be determined since data was not collected on spawners. Population estimates conducted in October suggest that the stream is underseeded for cutthroat trout.

Growth rates for cutthroat trout in Benewah were comparable to other Idaho trout streams. The food base was thought not to be limiting in Benewah since densities were above those of other Idaho trout streams.

The major problem with Benewah Creek is the severe degradation of riparian habitat associated with cattle grazing, and the input of sediment from bank sloughing and silvacultural practices. Restoration of the fisheries habitat associated with Benewah Creek may be achieved using land-owner eduction, fencing and revegetation of the riparian area.

4.1.4. Evans Creek

Evans Creek was also chosen as a primary tributary. No factors were directly designated as potentially limiting factors for Evans Creek (Table 4.5). However, cumulative land use practices in the drainage will eventually result in severe habitat degradation. No information on over-wintering habitat is available for Evans Creek and will be addressed in next years work. The major areas of concern in Evans Creek are silvacultural practices and limited widespread livestock grazing.

In the lower reaches of Evans Creek grazing practices have eroded stream banks. Sediment deposition is elevated in this area. This area can serve only as a migration corridor for adfluvial/fluvial cutthroat trout. No spawning and limited rearing habitat exists in the lower reach.

Spawning gravels are abundant in the middle reach of Evans Creek. Some sediment deposition occurs in low gradient areas due to non-point sediment recruitment as a result of silvacultural practices and grazing activities in this area.

Cutthroat trout densities in Evans Creek were the highest of all streams in this survey. Electrofishing surveys resulted in the capture of only cutthroat trout and sculpin spp. in Evans creek. Ages of cutthroat trout ranged from O-4+ fish. Population estimates for Evans Creek ranged from 9.0 fish/l00 m2 to 24.1 fish/l00 m2. These are the highest cutthroat trout densities obtained in surveyed streams but is still low compared to other Idaho streams. This suggests that cutthroat trout may be underseeded in this drainage. There seems to be a resident as well as adfluvial stock of cutthroat present in Evans Creek. However, the extent of each is undetermined at this time and will be addressed further next year.

Cutthroat trout growth and condition was also lower in comparison to other streams of the area. Benthic densities and diversities were determined to be good in comparison with other streams of similar size. Growth may be lower due to the limited amount of rearing habitat as well as intraspecific competition within selected areas.

Restoration alternatives for Evans Creek includes limiting livestock access along stream banks, preventing vehicular traffic within the stream channel and controlling erosional processes connected with silvacultural practices. Promoting bank stability in the lower section via riparian revegetation and fencing is also needed.

4.1.5. Alder Creek

No conclusive potential limiting factors could be established for Alder Creek (Table 4.5). However, cumulative land use practices including silvacultural and livestock grazing practices are the major activities that have contributed to non-point source sediment input. Over-wintering habitat was not assessed during the study period and will be addressed next year. A potential migration barrier exists on Alder Creek. Approximately one and half miles from the mouth a ten-to-fifteen foot cascade-like waterfall prevents passage of cutthroat to numerous stretches of spawning gravels.

Spawning habitat below the falls is somewhat limited, however, if access above the falls is provided, quantity of spawning habitat would not be a problem. Grazing and silvacultural practices have impacted the amount of siltation located within the stream channel, Rearing habitat is abundant above the falls, with adequate instream as well as overhanging cover.

A major problem associated with cutthroat trout survival in Alder Creek, excluding the waterfall, is the number and density of eastern brook trout located in the upper areas. Cutthroat trout densities were very low with no young of year fish being captured. Age classes captured included 3 and 4 year old fish above the falls. No data was collected below the falls due to an access problem.

However, data will be collected next year to determine species densities below the falls. Eastern brook trout densities in Alder Creek were high with all age classes 0-3+ being captured. This indicates a healthy viable population of eastern brook trout exists in Alder Creek. Population estimates conducted in October indicated that cutthroat trout were present but in very low numbers, whereas, eastern brook trout were very abundant. This suggests a possible reason for the low numbers of cutthroat trout. According to (cite reference)when cutthroat and brook trout exist in the same reach of stream, brook trout will actively displace cutthroat trout.

Management considerations for Alder Creek include the possibility of modifying the falls to provide adequate up and downstream passage, actively removing brook trout, while restocking cutthroat trout, as well as, limiting cattle access to stream banks and controlling erosion from silvacultural actives.

4.2. NON-TARGET TRIBUTARIES

Non-targeted tributaries are those streams that were eliminated from intensive physical and biological evaluation. Those non-targeted tributaries are; Bellgrove, Fighting, Sqauw, Plummer, Little Plummer creeks and Hell's Gulch. These streams were eliminated from further studies based on the results of the Missouri habitat evaluation method (see section 3.1.).

Factors that were considered to be potentially limiting trout production in these non-targeted streams include; lack of spawning, rearing, and overwintering habitat as well as temperature, water quantity and passage (Table 4.5).

Spawning gravels in all Coeur d'Alene tributaries are covered by large quantities of silt. The quantity and quality of this spawning habitat has been affected by land use practices within the basins. These practices include, but are not limited to; grazing, agriculture, silvaculture and other land-use activities.

Rearing habitat is affected by high water temperatures during summer and insufficient flow regimes. Maximum water temperatures associated with juvenile cutthroat trout is 15°C (Pratt, 1984, Baltz et *al* 1987). Elevated water temperatures observed in these systems during the summer months exceeded this maximum preference limit. Summer cover for cutthroat trout is normally associated with deep lateral scour and plunge pools with abundant cover (Peters, 1988). In stream habitat showed little diversity with deep pools lacking. The predominate habitat type observed for all non-target streams was shallow riffles and runs with depths averaging 3-6 inches. Overhanging bank vegetation was predominantly sparse. These habitat characteristics in addition to elevated substrate embeddeness levels all contribute to the degraded quality of spawning, rearing and overwintering fish habitat.

Relative abundance estimates conducted on these streams indicated that low populations of resident trout species exists. These low abundances were predicted given the lack of quality habitat.

4.3. CONCLUSION AND RECOMMENDATIONS

The economy of the Coeur d'Alene basin is centered around agriculture and timber production. However, tourism in northern Idaho is also on the rise, and is the fastest growing business in the area. With new restrictions being imposed on the timber industry and the shift towards tourism in northern Idaho, the basins focus must be shifted towards enhancement of the resources, including, clean water and the fisheries potential of the area.

In order to have an increase in the trout fishery in all selected targeted tributaries erosion control practices must be implemented and maintained. Sediment loads in all targeted streams must be reduced in order to maintain a viable cutthroat trout population. Also, access by livestock must be limited to allow revegetation of stream banks. This may include land owner education as well as fencing of certain sections of the stream channels. lnstream enhancement techniques will also be important to establish cover, and alter pool-riffle ratios.

Due to the low numbers of cutthroat trout found in all surveyed stream sections, hatchery supplementation, along with habitat enhancement efforts, will be the only viable way of increasing stock size. This is also true for the bull trout stocks present within these tributaries.

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APPENDIX A

Table A.1. Parameter and function description and values for Bellgrove Creek.

Parameter Function	Description	Value
P_1	1 Concrete bridge abutment, 3/4 miles from the mouth, causing a drop of a foot.	5
P_2	5-10% of watershed in urban development.	8
P_3	App. 45% of banks protected by perennial vegetation with fair canopy cover.	5
P_4	All segments show evidence of occasional erosion.	5
P_5	50% protected.	5
P_7	Substrate suitability poor to unacceptable	2
f_1	Minor, in lower part.	0.96
f_2	No impoundments	1 .0
f_3	High turbidity causing water quality problems.	0.5
f_4	Upper stream has high silt percentages.	0.7
f_5	Channel becomes intermittent in summer	0.5
f_6	Average maximum water temperatures above 19°C.	0.25
f_7	Poor habitat for all life history stages.	0.1
HI value		0.024

Table A.2. Parameter and function description and values for Squaw Creek.

Parameter/ Function	Description	Value
P_1	Minor manmade obstructions to free fish passage.	9
P_2	5-10% of watershed in urban development	8
P_3	App. 90% of banks protected by perennial vegetation with fair canopy cover.	9
P_4	Some segments show evidence of occasional erosion.	7
P_5	70% of watershed protected by land use practices.	7
P_7	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals	10
f_1	5% of channel modified due to channel realignment.	0.96
f_2	No impoundments	1.0
f_3	No pollutants detected	1.0
f_4	No apparent unstable material in channel	1.0
f_5	Channel becomes intermittent in early spring.	0.1
f_6	Water temp. below 14°C.	1.0
f_7	Poor habitat for all life stages.	0.1
HI value		0.08

Table A.3. Parameter and function description and values for Fighting Creek.

Parameter Function	Description	Value
P_1	1 concrete bridge abutment, 3/4 miles from the mouth, causing a drop of a foot	5
P_2	5-10% of watershed in urban development.	8
P_3	App. 60% of banks protected by perennial vegetation with fair canopy cover.	6
P_4	All segments show evidence of occasional erosion.	5
P_5	60% of watershed protected by land use practices.	6
P_6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P_7	Substrate suitability unacceptable for spawning and emergence.	1
f_1	5% of channel modified due to channel realignment	0.96
f_2	No impoundments.	1.0
f_3	Water quality influenced by turbidity.	0.8
f_4	High silt percentages throughout the stream.	0.4
f_5	Channel becomes intermittent in late summer.	0.7
f_6	Average maximum water temperatures above 19°C.	0.25
f_7	Habitat limited for all life stages.	0.6
HI value		0.19

Table A.4. Parameter and function description and values for Hells' Gulch.

Parameter Function	Description	Value
Pl	Culvert at mouth and one mile upstream causing passage problems.	7
P2	510% of watershed in urban development.	8
P3	Approximately 90% of banks protected by perennial vegetation with fair canopy cover.	9
P4	Some segments show evidence of occasional erosion.	9
P5	80% of watershed protected by land use practices.	8
P6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P7	Substrate suitability for spawning and emergence poor.	4
f l	App. one mile from mouth, 30% of stream has been realigned.	0.76
f2	Midstream reach impounded during a 1 in 50 year flood event.	0.5
f3	No pollutants detected.	1 .0
f4	Traces of fine material in quiet areas.	0.9
f5	Channel becomes intermittent in late spring.	0.25
f6	Average maximum water temperatures above 15°C.	0.75
f7	Poor habitat for all life stages.	0.1
HI value		0.05

Table AS. Parameter and function description and values for Plummer Creek.

Parameter/ Function	Description	Value
P_1	No manmade obstructions to free fish passage.	10
P2	<5% of watershed in urban development.	10
P3	App.90% of banks protected by perennial vegetation with fair canopy cover.	9
P_4	All segments show evidence of occasional erosion.	5
P_5	50% of watershed protected by land use practices.	5
P_6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P7	Substrate suitability for spawners and emerging fry poor to unacceptable	3
fl	No significant channel modifications encountered.	1 .0
f_2	No impoundments.	1 .0
f_3	Water quality influenced by turbidity	0.8
f_4	Upper stream has high silt percentages.	0.7
f_5	Channel becomes intermittent in late summer.	0.5
f_6	Average maximum water temperatures above 18°C.	0.4
f_7	Poor habitat for adults and limited habital for other life history stages.	0.5
HI value		0.42

Table A.6. Parameter and function description and values for Little Plummer Creek.

Parameter/ Function	Description	Value
P_1	Large culvert two mile from confluence with Plummer Creek which caused a passage barrier.	8
P2	5-10% of watershed in urban development	8
P_3	50% of banks protected by perennial vegetation with fair canopy cover.	5
P_4	All segments show evidence of occasional erosion.	5
P_5	70% of watershed protected by land use practices.	7
P_6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	**10**
P7	Substrate suitability for spawning and emergence acceptable to poor.	5
f l	Approximately 0.5% channel realignment	0.996
f_2	No impoundments.	1 .0
f_3	No pollutants detected.	1 .0
f_4	Quiet areas covered by fine material, deep pools restricted to areas of greatest scour	0.8
f_5	Flow perennial, but passage problems due to low base flow.	**0.65**
f_6	Average maximum water temperatures 18°C and above.	0.4
f_7	Poor habitat for adults and limited habitat for other life stages.	0.5
HI value		0.71

Table A.7. Parameter and function description and values for Lake Creek.

Parameter/ Function	Description	Value
P_1	No manmade obstructions.	10
P_2	<5% of watershed in urban development.	10
P_3	App. 90% of banks protected by perennial vegetation with fair canopy cover.	9
P_4	Some segments show evidence of occasional erosion.	8
P_5	60% of watershed protected by land use practices.	6
P_6	5% of watershed controlled by irrigation <5% controlled by domestic withdrawals.	8
P_7	Substrate suitability acceptable to poor.	6
f_1	No significant channel modifications encountered.	1.0
f_2	No significant impoundments.	1.0
f_3	Low pH and high turbidity in west fork of Lake Creek caused water quality problems in mainstem.	0.85
f_4	Silt present in stream bed with areas of heavy deposition.	0.95
f_5	Perennial flow with no passage problems	1.0
f_6	Average maximum water temperatures 17°C and above.	0.5
f_7	Adequate habitat for all life stages.	0.95
HI value		3.12

Table A.8. Parameter and function description and values for Benewah Creek.

Parameter/ Function	Description	Value
P_1	No manmade obstructions.	10
P2	<5% of watershed in urban development.	10
P3	60% of banks protected by perennial vegetation with fair to limited canopy cover.	6
P_4	Some segments show evidence of occasional erosion.	7
P_5	60% of watershed protected by land use practices.	6
P_6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P7	Substrate suitability acceptable.	7
f1	No significant channel modifications.	1.0
f_2	No impoundments.	1.0
f_3	No pollutants detected.	1.0
f_4	Traces of unstable material in stream channel.	0.95
f_5	Perrianeal flow, but passage problems due to low base flow.	0.80
f_6	Average water temperatures higher then 17°C in places during summer.	0.5
f_7	Good habitat for all life stages.	1.0
HI value		3.04

Table A.9. **Parameter and function description and values for Evans Creek.**

Parameter Function	Description	Value
P_1	No manmade obstructions.	10
P2	5-10% of watershed in urban development.	8
P3	50% of banks protected by perennial vegetation with fair to limited canopy cover.	4
P_4	All segments show evidence of occasional erosion, with continuous erosion in lower section of stream.	4
P_5	50% of watershed protected by land use practices.	5
P_6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P7	Substrate suitability acceptable to good	8
f l	Some channel realignment in the lower stream channel.	0.96
f_2	No impoundments	1.0
f3	High turbidity during runoff	0.9
f_4	Traces to minor amounts of silt in stream channel.	0.85
f_5	Perennial flow, no passage problems.	1 .0
f_6	Water temperatures below 14°C.	1 .0
f_7	Good habitat for all life stages.	1 .0
HI value		4.93

Table A.IO. Parameter and function description and values for Alder Creek.

Parameter Function	Description	Value
P1	No manmade obstructions.	10
P2	<5% of watershed in urban development.	10
P3	90-100% of banks protected by perennial vegetation.	9
P4	Minor erosion of the floodplain.	10
P5	90% of watershed protected by land use practices.	9
P6	<1% of watershed controlled by irrigation. <5% controlled by domestic withdrawals.	10
P7	Substrate suitability acceptable to good.	8
fl	No significant channel modifications.	1 .0
f2	No impoundments.	1.0
f3	No pollutants detected.	1 .0
f4	Traces of unstable material in quiet areas in the upper section of stream.	0.9
f5	Perrianel flow with no passage problems.	1.0
f6	Average maximum water temperatures of 16°C.	0.65
f7	Good habitat for all life stages.	1 .0
HI value		5.52

APPENDIX B

Table B.l. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during June, 1991.

Site Shock time (min) Shock Area (ft2	Lower *	Middle 88.1 15,450	Upper 66.8 8820
Cutthroat trout		3 (2.2%)	-
Redside shiner		21 (15.2%)	-
Sculpin spp.		81 (58.7%)	33 (100%)
Western speckled dace		33 (23.9%)	
Total		**138**	**33**

Table B.2. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Plummer and Little Plummer creeks during June, 1991.

Site Shock time (min) Shock Area (ft2	Lower mainstem 125.4 17,130	Middle mainstem 92.7 16,080	Upper Little Plummer 147.9 12180
Cutthroat trout	4 (3.3%)	0	0
Eastern brook trout	2 (1.7%)	2 (1.0%)	1 (0.2%)
Redside shiner	0	31 (14.8%)	13 (2.6%)
Sculpin spp.	89 (73.6%)	0	0
Northern squawfish	4 (3.3%)	0	0
Western speckled dace	12 (9.9%)	176 (84.2%)	489 (97.2%)
Longnose sucker	10 (8.3%)	0	0
Total	**121**	**209**	503

Table B.3. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Fighting Creek during June, 1991.

Site Shock time (min) Shock Area (ft²)	Lower 56.9 13,112	Middle*	Upper*
Cutthroat trout	25 (92.6%)		
Longnose sucker	2 (7.4%)		
Total	27		

Table 8.4. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Hell's Gulch Creek during June 1991.

Site Shock time (min) Shock Area (ft²)	Lower 58.6 11,390.6	Middle*	Upper*
Cutthroat trout	1 (11.1%))		
Eastern brook trout	8 (88.8%)		
Total	9		

Table B.5. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during June 1991.

Site Shock time (min) Shock Area (ft²	Lower *	Middle 87.1 14,419	Upper 100.7 11,291.7
Cutthroat trout		1 (4.5%)	2 (.9%)
Eastern brook trout		3 (13.6%)	58 (25%)
Longnose sucker		6 (27.3%)	0
Sculpin spp.		12 (54.5%)	172 (74.1%)
Total		22	232

Table 8.6. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during June 1991.**

Site	Lower	Middle *	Upper
Shock time (min)	97.9		40
Shock Area (ft²)	8498		13,770
Cutthroat trout	17 (11.1%)		13 (15.7%)
Sculpin spp.	136 (88.9%)		70 (84.3%)
Total	**153**		83

Table 8.7. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during June 1991.**

Site	Lower	Middle	Upper
Shock time (min)	152.1	114.9	59.3
Shock Area (ft²)	18,660	20,100	22,380
Cutthroat trout	6 (4.5%)	9 (5.2%)	0
Eastern brook trout	0	2 (1.2%)	1 (0.3%)
Longnose sucker	6 (4.5%)	4 (2.3%)	13 (4.0%)
Pumpkinseed	5 (3.7%)	1 (0.6%)	0
Redside shiner	17 (12.7%)	43 (24.9%)	123 (38%)
Sculpin spp.	27 (20.1%)	6 (3.5%)	1 (0.3%)
Northern squawfish	3 (2.2%)	1 (0.6%)	0
Western speckled dace	69 (51.5%)	107 (61.8%)	186 (57.4%)
Yellow perch	1 (0.7%)	0	0
Total	**134**	**173**	324

• represent areas that were inaccessible or otherwise posted.

APPENDIX C

Table C.I. Mean densities of benthic macroinverbrates (#/m2) collected in Hess samples from Benewah Creek during 1991, (samples sizes enclosed in parenthesis).

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June	*	1986.7 (3)	550.0 (3)	1268.4 (6)
August	843.3 (3)	2753.3 (3)	3836.7 (3)	2477.8 (9)
October	3216.7 (3)	4950.0 (3)	3673.3 (3)	3946.7 (9)
Annual mean	2038.3 (6)	3230.0 (9)	2686.7 (9)	2564.3 (24)

Table C.2. Mean densities of benthic macroinvertebrates (#/m2) collected in Hess samples from Alder Creek during 1991, (sample sizes enclosed in parenthesis).

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		1640.0 (3)	773.3 (3)	1206.7 (6)
August		1730.1 (3)	128.7 (3)	929.4 (6)
October		896.7 (3)	2063.3 (3)	1480.0 (6)
Annual mean		1422.2 (9)	988.4 (9)	1205.4 (18)

Table C.3 Mean densities of benthic macroinvertebrates (#/m2) collected in Hess samples from Evans Creek during 1991, (sample sizes enclosed in paranthesis).

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		1523.3 (3)	2686.7 (3)	2105.0 (6)
August		2590.0 (3)	2686.7 (3)	2638.4 (6)
October		6026.7 (3)	1796.7 (3)	3911.7 (6)
Annual mean		3380.0 (9)	2388.9 (9)	2885.0 (18)

Table C.4. Mean densities of benthic macroinvertebrates (#/m2) collected in Hess samples from Lake Creek during 1991, (sample sizes enclosed in paranthesis).

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		*	269.5 (3)	269.5 (3)
August		153.3 (3)	2686.7 (3)	1420.0 (6)
October		333.3 (3)	1686.7 (3)	1010.0 (6)
Annual mean		243.3 (6)	2356.1 (9)	899.8 (15)

Table C.5. **Mean densities of benthic macroinverbrates (#/m3) collected in drift samples from Benewah Creek during 1991, (samples sizes enclosed in parenthesis).**

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June	*	73.4 (2)	101.9 (1)	87.7 (3)
August	14.0 (2)	127.3 (2)	17.3 (2)	53.1 (6)
October	234.8 (2)	558.9 (2)	623.2(2)	472.3 (6)
Annual mean	124.4 (4)	253.2 (6)	247.5 (5)	1204.4 (15)

Table C.6. **Mean densities of benthic macroinvertebrates (#/m3) collected in drift samples from Alder Creek during 1991, (sample sizes enclosed in parenthesis).**

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		160.3 (2)	3.6 (2)	81.9 (4)
August		220.1 (2)	247.5 (2)	234.8 (4)
October		247.0 (2)	325.5 (2)	286.2 (4)
Annual mean		209.8 (6)	192.2 (6)	200.9 (12)

Table C.7. **Mean densities of benthic macroinvertebrates (#/m3) collected in drift samples from Evans Creek during 1991, (sample sizes enclosed in paranthesis).**

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		41.7 (2)	57.1 (2)	49.4 (4)
August		456.5 (2)	53.7 (2)	255.1 (4)
October	86.7 (2)	344.4 (2)	1046.4 (2)	492.5 (6)
Annual mean	28.9 (2)	280.9 (6)	385.7 (6)	249.2 (14)

Table C.8. **Mean densities of benthic macroinvertebrates (#/m3) collected in drift samples from Lake Creek during 1991, (sample sizes enclosed in paranthesis).**

Month	Lower (X)	Middle (X)	Upper (X)	Total (X)
June		•	307.5 (2)	307.5 (2)
August		5.1 (2)	446.1 (2)	225.6 (4)
October		84.0 (2)	4.2 (2)	44.1 (4)
Annual mean		44.6 (4)	252.6 (6)	192.4 (10)